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Cardiovascular Surgery

CLINICAL OUTCOMES FOLLOWING REVASCULARIZATION IN STEMI AND NSTEMI PATIENTS: A PROSPECTIVE STUDY

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ABSTRACT Myocardial infarction (MI), commonly known as a heart attack, is a life-threatening condition resulting from restricted or stopped blood flow to the heart muscle. It stems from destabilization of atherosclerotic plaques, leading to ST-elevation myocardial infarction (STEMI) or non-ST-elevation myocardial infarction (NSTEMI). Key risk factors include age, hypertension, diabetes, and lifestyle habits. The research seeks to improve understanding of myocardial infarction management through a comparative study of STEMI and NSTEMI cases treated via invasive revascularization. **Objective:** This study aims to identify and analyze differences in patient characteristics, treatment approaches, and outcomes of cardiogenic shock based on myocardial infarction classification: STEMI versus NSTEMI.**Background:** This study is a prospective, observational investigation conducted at a single center, the Department of Cardiology, KIMS Hospital, Kondapur. The data collection period spanned six months, with information sourced from electronic medical records dated between September 2024 and March 2025. The study population consisted of 108 patients (Males:91, Females:17) diagnosed with ST-elevation myocardial infarction (STEMI) or non-ST-elevation myocardial infarction (NSTEMI), who underwent revascularization therapy, specifically PCI (percutaneous coronary intervention) or CABG (coronary artery bypass grafting).This study highlights the vital role of invasive revascularization therapy, particularly PCI, in managing acute myocardial infarction, especially in STEMI patients. It compares STEMI and NSTEMI cases, identifying differences in clinical presentation, risk factors, and outcomes. The study underscores the importance of risk stratification tools like GRACE, Killip, TIMI, HEART, and CHA2DS2-VASc in optimizing treatment. Overall, it emphasizes the effectiveness of revascularization therapy and calls for further research to refine treatment protocols and improve patient care.

KEYWORDS : Myocardial Infarction, St-elevation Myocardial Infarction, Non St-elevation Myocardial Infarction, Revascularization, Percutaneous Coronary Intervention(pci), Coronary Artery Bypass Grafting(cabg), Grace, Killip, Timi, Heart Score, Cha2ds2-vasc Score

INTRODUCTION

Myocardial infarction (MI), commonly referred to as a "heart attack," represents a critical cardiovascular event with high global mortality and morbidity. It is fundamentally caused by acute ischemia—a condition where blood flow to the myocardium is abruptly reduced or completely interrupted. The consequences of MI, if untreated, are catastrophic, ranging from irreversible myocardial necrosis to life-threatening complications such as cardiogenic shock and sudden cardiac death. These outcomes necessitate prompt diagnosis and intervention to mitigate the extent of heart muscle damage and optimize patient prognosis[1,2,7].

MI typically arises from underlying coronary artery disease (CAD), which is characterized by the progressive buildup of atheromatous plaques within the coronary arteries. These plaques consist of lipid deposits, inflammatory cells, and connective tissue, which collectively contribute to luminal narrowing and impaired coronary perfusion[3]. The rupture of these plaques, an acute event precipitated by mechanical stress or inflammatory activation, exposes thrombogenic material to the bloodstream, initiating the formation of an occlusive thrombus. This thrombus disrupts the delicate balance between myocardial oxygen supply and demand, leading to ischemia and, eventually, myocardial necrosis[2].

Clinically, MI is classified within the spectrum of acute coronary syndromes (ACS), which encompasses unstable angina, ST-segment elevation myocardial infarction (STEMI), and non-ST-segment elevation myocardial infarction (NSTEMI). This classification, based on findings from a 12-lead electrocardiogram (ECG), is pivotal in guiding therapeutic strategies. STEMI is characterized by complete coronary artery occlusion and manifests with pronounced ST-segment elevation on the ECG—a hallmark of transmural myocardial injury. In contrast, NSTEMI results from incomplete coronary obstruction, with ischemic changes limited to the subendocardial region, presenting without ST-segment elevation[3,5]. While both conditions share common pathophysiological mechanisms, their clinical presentations, management protocols, and long-term outcomes differ significantly.

The burden of MI is compounded by various modifiable and non-modifiable risk factors, including advancing age, hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, and sedentary lifestyle[1,2]. These factors contribute to endothelial dysfunction, atherosclerotic plaque development, and pro-thrombotic states, underscoring the need for preventative strategies and early intervention. Furthermore, disparities in healthcare access, socioeconomic status, and patient demographics influence the incidence and outcomes of MI, highlighting the importance of equitable healthcare delivery[4,5].

The management of MI has undergone significant evolution, with invasive revascularization techniques such as percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) emerging as cornerstone therapies. PCI involves the mechanical restoration of blood flow through angioplasty and stent placement, offering superior efficacy in rapidly alleviating coronary obstruction[8,9]. CABG, a surgical approach, provides durable revascularization in patients with complex coronary anatomy or multivessel disease. These interventions are further supported by adjunctive pharmacotherapy, including antiplatelets, anticoagulants, beta-blockers, statins, and renin-angiotensin system inhibitors, aimed

at reducing the risk of recurrent ischemic events and promoting myocardial recovery[5,10].

Risk stratification tools such as the GRACE, Killip, TIMI, HEART, and CHA_2DS_2-VASc scores have revolutionized MI management by enabling precise prognostic assessments and tailored therapeutic approaches. These scoring systems integrate clinical variables such as age, comorbidities, hemodynamic stability, and biomarker levels to stratify patients into risk categories, guiding decisions regarding the intensity of care and the need for invasive interventions[6,10,14,15,18,19,20].

Despite advancements in MI management, challenges persist in improving long-term outcomes and minimizing complications. STEMI patients often present with acute severity requiring urgent intervention, whereas NSTEMI cases necessitate meticulous long-term management, given their association with higher comorbidities. In this context, invasive revascularization therapy serves as a pivotal strategy in reducing mortality, alleviating symptoms, and improving quality of life[11].

This study provides a comprehensive comparison of STEMI and NSTEMI patients undergoing invasive revascularization therapy, focusing on variations in clinical characteristics, therapeutic approaches, and outcomes. By analyzing patient data collected over six months, the research aims to identify trends and generate insights that will inform clinical practice, refine treatment protocols, and enhance patient care. The findings contribute to the growing body of knowledge surrounding myocardial infarction management, emphasizing the importance of individualized strategies and collaborative efforts in addressing this global health challenge[12].

MATERIALS AND METHODS

Study Design: This study is a prospective, observational investigation conducted at a single centre.

Study site: Department of cardiology, KIMS Hospitals, Kondapur, Hyderabad.

Duration of the study: Data was obtained from electronic medical records that meet the inclusion criteria and is collected over a six-month period.

Study population: Patients with STEMI AND NSTEMI who underwent revascularization therapy.

Sample size: We observed a total of 108 patients during this study.

Study criteria:

Inclusion criteria:

1. Patients aged 18-80 and above years.
2. Includes both genders.
3. Patients who were diagnosed with acute myocardial infarction.
4. Indicated for revascularization therapy (PCI & CABG).
5. Patients able to abide by the protocol throughout the study.
6. Patients willing to comply with all study requirements.
7. All patients signed written informed consent form before the treatment.

Exclusion criteria:

1. Severe comorbid conditions limiting survival (e.g., advanced cancer and end-stage
renal disease).
2. Concurrent severe medical conditions.
3. Any history of hypersensitivity to any component of the treatment.
4. Previous surgical history within past 6 months.
5. Psychiatric illness compromising understanding of information or completion of
study.
6. Inability to sign informed consent or to undergo medical follow-up of the treatment
for social or psychological reasons.
7. Pregnant and lactating women.

Data collection source:

- Study material: Relevant data is extracted from electronic medical records from September 2024 to March 2025, with prior approval from the institution

Statistical analysis:

After collection of data it was entered into MS EXCEL, Descriptive statistics, including the number of observations, percentages, mean, and standard deviation (SD), were used to summarize quantitative variables. The data will be analyzed using GRACE, KILLIP, HEART and CHA2DS2-VASC SCORES and will be represented
in tabular and graphical forms.

GRACE Score

A risk assessment tool for predicting mortality and major adverse cardiac events in patients with acute coronary syndrome (ACS) is the GRACE score (Global Registry of Acute Coronary Events). To help with risk stratification and management, it assesses clinical factors like age, heart rate, blood pressure, creatinine levels, the presence of cardiac arrest at admission, ST-segment changes, and elevated cardiac biomarkers [14,15].

Killip Score

A clinical assessment tool called the Killip score is used to determine how severe heart failure is in patients who have had a myocardial infarction (MI). It aids in risk stratification and treatment planning by predicting the probability of unfavorable outcomes, such as complications and mortality[16,17].

TIMI Score

A clinical risk assessment tool called the TIMI Score (Thrombolysis in Myocardial Infarction Score) is used to help patients with acute coronary syndromes (ACS) make treatment decisions by estimating the likelihood of adverse cardiac events, such as heart attacks or death[15,18].

HEART Score

When a patient has chest pain, the emergency room uses the HEART score, a risk assessment tool, to determine the likelihood of major adverse cardiac events (MACE)[20,21].

CHA_2DS_2-VASc Score

Patients with atrial fibrillation (AF) can have their risk of stroke assessed using the CHA_2DS_2-VASc score. It helps determine whether anticoagulation therapy is necessary to lower the risk of stroke [17,22].

Designing the data collection form:-

A suitable data collection form was designed to collect, document and analyse the data.

Data collection form includes the collecting information related to:

- Patients demographic details
- Chief complaints
- Past medical history
- Family history
- Physical examination
- Any co-morbidities
- Laboratory investigation
- Contact details and other relevant information

RESULT

We carried out a prospective observational study over six months in a hospital to assess clinical outcomes after invasive revascularization therapy in patients with myocardial infarction, comparing STEMI and NSTEMI cases. During our study we observed 108 subjects to evaluate the clinical outcomes after invasive revascularization in patients with myocardial infarction.

Distribution based on gender

Table 1: Distribution of patients based on gender

Subjects	Number of patients
Total subjects	108, (n=108, SD=9.71)
Males	91
Females	17

We have observed a total of 108 subjects with myocardial infarction treated with invasive revascularization therapy of them 84.3% were found to be males (n=91) and 15.7% were found to be females (n=17).

Distribution based on age

Table 2: Distribution of patients based on age

Age	Total no. of patients	Percentage
31-40	1	0.93%
41-50	13	12.04%

51-60	32	29.63%
61-70	32	29.63%
71-80	22	20.37%
81-100	8	7.41%

In 108 patients who are diagnosed with MI and treated with revascularization therapy majority of the patients are in the age group of 51-60 (32 patients-29.63%) and 61-70 (32 patients-29.63%)

followed by other age groups 71-80(22 patients-20.37%), 41-50 (13 patients-12.04%), 81-100(8 patients-7.41%). The least frequency was found in age group of 31-40 (1 patients-0.93%).

Distribution based on Comorbidities

Table 3: Distribution of patients based on Comorbidities

Comorbidity	Total no. of patients	Percentage
HTN	65	60.18%
DM	66	61.11%
Dyslipidemia	13	12.03%
Other	23	21.29%
Nil	15	13.88%

The above table presents the distribution of patients based on the presence of comorbidities. It categorizes patients into different health conditions, showing their prevalence among the study population. Diabetes Mellitus (DM) was observed in 66 patients (61.11%), making it the most common comorbidity. Hypertension (HTN) was present in 65 patients (60.18%), showing a similar prevalence to diabetes. Dyslipidemia was found in 13 patients (12.03%). Other comorbid conditions were reported in 23 patients (21.29%). Patients without any comorbidities accounted for 15 cases (13.88%).

Distribution based on Diagnosis

Table 4: Distribution of patients based on Diagnosis

Type of MI	Total	Percentage
STEMI	70	64.8%
NSTEMI	38	35.2%

The majority of the patients 70(64.8%) were diagnosed with ST-elevation myocardial infarction(STEMI) and 38 patients (35.2%) were diagnosed with Non ST-elevation myocardial infarction(NSTEMI).

Distribution based on CAG(Coronary Angiogram) results

Table 5: Distribution of patients based on CAG(Coronary Angiogram) Results

Result	Total	Percentage
Triple vessel disease	49	43.36%
Double vessel disease	43	38.05%
Single vessel disease	16	14.16%

The patients have undergone Coronary Angiogram(CAG) to find any blockages or narrowing in blood vessels. Majority of the patients were found to have triple vessel disease (49-43.36%) followed by double vessel disease in 43 patients (38.05%).The least number of subjects were found to have single vessel disease 16(14.16%).

Distribution based on Procedure

Table 6: Distribution of patients based on Procedure

Procedure	Total no. of patients	Percentage
PCI	96	88.89%
CABG	12	11.11%

The table presents the distribution of patients based on the type of revascularization procedure performed. It categorizes patients into two groups: those who underwent Percutaneous Coronary Intervention (PCI) and those who underwent Coronary Artery Bypass Grafting (CABG).

PCI was performed on 96 patients, accounting for 88.89% of the total cases.

CABG was performed on 12 patients, making up 11.11% of the total cases.

Distribution based on evaluation of pain

Table 7: Distribution of patients based on evaluation of pain

Pain scale	No. of patients	Percentage
1	12	10.91%
2	62	56.36%
3	20	18.18%
4	10	9.09%
5	2	1.82%
6	1	0.91%
7	1	0.91%

The table presents distribution of patients based on pain evaluation using a pain scale from 1 to 7, with the number of patients in each category:

Pain Scale 2 had the highest number of patients (62 patients, 56.36%).
Pain Scale 3 was the second most common (20 patients, 18.18%).
Pain Scale 1 had 12 patients (10.91%).
Pain Scale 4 had 10 patients (9.09%).
Higher pain scores (5, 6, and 7) were rare, with only 1-2 patients each.

Distribution based on Troponin results

Table 8: Distribution of patients based on Troponin results

Result	No. of patients	Percentage
Positive	66	61.1%
Negative	42	38.9%

The table provides the distribution of patients based on their troponin test results:

66 patients (61.1%) had positive troponin results, indicating myocardial injury.

42 patients (38.9%) had negative troponin results, meaning no detectable cardiac injury.

Distribution based on Medications

Table 9: Distribution of patients based on Medications

Medication	No. of Patients	Percentage
Antiplatelets	106	98.14%
P2Y12 Inhibitors	64	59.25%
Thienopyridines	39	36.11%
Anticoagulants	4	3.7%
Nitrates	32	29.62%

The table shows the distribution of patients based on medication:
Antiplatelets were the most commonly used (106 patients, 43.3%).
P2Y12 inhibitors were the second most used (64 patients, 26.1%).
Thienopyridines were used by 39 patients (15.9%).
Nitrates were prescribed to 32 patients (13.1%).
Anticoagulants were the least used (4 patients, 1.6%).

Distribution of GRACE score based on risk category

1.Most patients are in Low-Risk Category (~78 cases).
2.Fewer patients are in the Medium-Risk Category (~26 cases).
3.Very few patients are in the High-Risk Category (~4 cases).

Distribution of patients based on KILLIP CLASS

1.Killip Class I (No signs of heart failure) is second most common (27).
2.Killip Class II (Moderate Heart Failure) has the highest count (33).
3.Killip Class III (Severe Heart Failure) is the less common (14).
4.Killip Class IV (Cardiogenic Shock) has no subject fall into this.

Distribution of patients based on TIMI Scores (0-14)

1.Most Patients Have TIMI scores between 3 and 5.
2.TIMI score of 4 is the Most common (~35 patients).
3.Few patients have very low (0-1) or high (7+) TIMI scores.

Distribution of patients based on Heart Score

1.Most patients have HEART score between 5 and 7.
2.HEART score of 6 is the most common (~38 patients).
3.Lower and Higher HEART scores (4 and above 8) are less frequent.

Distribution of patients based on CHA2DS2-VASc Score

1.Most patients have CHA2DS2-VASc scores between 2 and 4.
2.CHA2DS2-VASc score of 3 is the most common (~34 patients).
3.Few patients have extremely low (0) or high (5-6) scores.

DISCUSSION

The present study provides a comparative analysis of patients with ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI) who underwent invasive revascularization therapy. The results highlight significant

differences in patient characteristics, comorbidities, and clinical outcomes between the two groups[22,23].

The population's baseline characteristics as seen in this study showed a predominance of males (84.3%) over females (15.7%), with the majority of patients falling within the age range of 51–70 years. Hypertension and diabetes were the most common comorbidities, present in 60.18% and 61.11% of patients, respectively. These findings are consistent with existing literature that identifies hypertension and diabetes as major risk factors for myocardial infarction.

In terms of diagnosis, STEMI was more prevalent (64.8%) compared to NSTEMI (35.2%). This is noteworthy because STEMI patients typically present with more severe clinical manifestations and require prompt intervention. The distribution of coronary artery disease (CAD) revealed that triple vessel disease was the most common finding (43.36%), followed by double vessel disease (38.05%) and single vessel disease (14.16%).

The primary mode of revascularization in the study cohort was percutaneous coronary intervention (PCI), performed in 88.89% of patients, while coronary artery bypass grafting (CABG) was performed in 11.11% of patients. This preference for PCI aligns with current guidelines that recommend PCI as the first-line treatment for acute myocardial infarction due to its efficacy and lower invasiveness.
Clinical outcomes were evaluated using various scoring systems, including GRACE, KILLIP, TIMI, HEART, and CHA2DS2-VASc scores. The majority of patients fell into the low-to-moderate risk categories for adverse cardiac events. Notably, the GRACE score indicated that most patients were at low risk for mortality, while the Killip classification showed that moderate heart failure was the most common presentation[14,15,16,17,18,19,20,21].

The study also assessed the effectiveness of invasive revascularization therapy in alleviating pain and improving troponin levels. The evaluation of pain using a standardized pain scale revealed a significant reduction in pain levels post-intervention. Furthermore, 61.1% of patients tested positive for troponin, indicating myocardial injury, which underscores the importance of timely revascularization to minimize cardiac damage.

- Overall observations of our study:

Risk Factors and Comorbidities
- **STEMI**: Predominantly occurs in younger patients with fewer comorbidities.
- **NSTEMI**: More common in older patients with a higher prevalence of comorbid conditions like hypertension, diabetes, and dyslipidemia.

Revascularization Techniques
- **STEMI**: The best course of action to minimize heart damage and restore blood flow is immediate percutaneous coronary intervention (PCI).
- **NSTEMI**: Depending on the severity of the condition and the patient's characteristics, PCI or coronary artery bypass grafting (CABG) may be used as a treatment.

Outcomes and complications
- **STEMI**: Higher initial mortality rate due to the severity of the condition. Complications include ventricular rupture, arrhythmias, and cardiogenic shock.
- **NSTEMI**: Lower initial mortality rate but higher long-term mortality due to underlying comorbidities. Complications include heart failure and recurrent ischemic events.

Clinical Scores and Risk Stratification
- **STEMI**: Higher KILLIP class and TIMI score due to the acute nature of the condition. GRACE score often indicates a high risk of mortality and adverse events.
- **NSTEMI**: Higher HEART and CHA2DS2-VASc scores due to the presence of comorbidities. Often falls into low-to-moderate risk categories for immediate adverse events but requires careful long-term management.

Pain and Biomarker Evaluation
- **STEMI**: Patients typically present with severe chest pain and higher troponin levels indicating extensive myocardial damage.
- **NSTEMI**: Chest pain may be less severe, and troponin levels vary. Requires careful monitoring and evaluation.

Long-Term Management
- **STEMI**: Focus on preventing recurrent events through lifestyle modifications, medication adherence, and regular follow-ups.
- **NSTEMI**: Emphasis on managing comorbidities, preventing heart failure, and minimizing the possibility of repeated ischemic episodes.

These differences underline the importance of tailored treatment strategies for STEMI and NSTEMI patients to optimize clinical outcomes and improve survival rates[13,22,23].

CONCLUSION

This study emphasizes the crucial role of invasive revascularization therapy in managing acute myocardial infarction, particularly for patients with STEMI. The comparative analysis of STEMI and NSTEMI patients reveals distinct differences in clinical presentation, risk factors, and outcomes, providing valuable insights for developing more tailored treatment approaches.

Percutaneous coronary intervention (PCI), a key approach in invasive revascularization, has been shown to improve clinical outcomes and reduce myocardial injury, as indicated by troponin levels. Furthermore, risk stratification tools such as GRACE, Killip, TIMI, HEART, and CHA2DS2-VASc are essential for identifying high-risk patients and optimizing their treatment.

Overall, this study provides valuable insights into the effectiveness of revascularization therapy in myocardial infarction and emphasizes the need for continued research to refine treatment protocols and enhance patient care and also provides a comprehensive comparison and highlights the critical role of invasive revascularization therapy in managing these conditions.

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Conflicts of Interest
The authors declare no conflicts of interest.

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