# Outcomes of urgent coronary artery bypass graft surgery following non-ST elevation myocardial infarction


## Abstract

**Background:** Non-ST elevation myocardial infarction (NSTEMI) significantly reduces patient survival, a condition that is essential for the optimization of results and the restoration of effective vascular flow multivessel coronary artery disease, Emergency coronary artery bypass grafting (CABG) is frequently contemplated. In the aftermath of NSTEMI, the objective of this investigation is to assess the results of urgent CABG, to prioritize risk stratification through the use of the Global Registry of Acute Coronary Events (GRACE) score

**Methods:** An analysis of 60 consecutive patients who underwent emergent CABG following NSTEMI was conducted retrospectively. Data on patients were obtained from a prospectively compiled database, and the GRACE score was implemented to evaluate the probability of mortality. Patients were divided into three risk categories: low (<10%), intermediate (10-19%), and high (≥20%), based on their predicted mortality percentages.

**Results:** Patients in the high-risk group (Group 3) exhibited significantly lower Euro Scores and ejection fractions (EF) than those in the low and intermediate groups, as demonstrated by the study. Additionally, the cross-clamp time was notably longer in Group 3, highlighting the urgency of intervention in this population The postoperative complications' overall incidence did not differ significantly between the groups. Even though Group 3 exhibited an increased in-hospital mortality rate.

**Conclusions:** The findings underscore the importance of timely intervention and tailored management strategies for NSTEMI patients, more specifically, the individuals who have been classified as high-risk by the GRACE score. This study contributes to the growing body of literature supporting urgent CABG as a lifesaving procedure and emphasizes the need for further research to optimize outcomes in this vulnerable patient population. The results advocate for a multidisciplinary approach to enhance perioperative care and improve survival rates among NSTEMI patients undergoing CABG.



**Keywords:** Non-ST elevation myocardial infarction, Coronary artery bypass grafting, Acute Coronary Events score, Multivessel coronary artery disease, Postoperative complications, Urgent intervention, Patient outcomes

## 1. Introduction

Myocardial infarction (MI) is one of the primary causes of mortality worldwide and is one of the acute symptoms of coronary artery disease (CAD). As "time is muscle," persistent ischemia remains a significant risk factor for this condition, leading to loss of contractility and/or cardiac cell death with potentially fatal arrhythmias. Therefore, restoring coronary blood flow as quickly as possible is the obvious primary therapeutic objective in MI. [1]

MI is typically classified into two principal categories: ST-elevation MI (STEMI) and non-ST-elevation MI (NSTEMI). Acute coronary syndrome (ACS) status is also conferred upon unstable angina, as it serves as the immediate background for MI .[2]

Coronary artery bypass grafting (CABG) is a safe and viable alternative for patients with acute coronary syndrome (ACS). Additionally, it is an appropriate treatment for severe multivessel disease, diabetes mellitus, and PCI failure. CABG can facilitate the rapid completion of revascularization and mitigate heart ischemia. [3]

However, In the past, patient management has been less aggressive in terms of the time point of revascularization in NSTEMI, in contrast to STEMI, ischemia is considered less critical. In addition, the argument has been advanced that the likelihood of complications during surgery is reduced in cases of NSTEMI by deferring coronary artery bypass grafting (CABG) .[1]

Conversely, patients with multivessel coronary artery disease who exhibited NSTEMI exhibited enhanced survival, as well as a decrease in the incidence of significant adverse cardiac and cerebrovascular events and readmission following revascularization with CABG, as demonstrated by specific studies. The decision to perform urgent CABG in NSTEMI patients is considered controversial. [4,5]

The Global Registry of Acute Coronary Events (GRACE) score is one of the most frequently used scores in the daily clinical practice of identifying in-hospital hazards and long-term mortality for ACS patients [6]. In an effort to anticipate risk, the GRACE risk score model employs eight variables: age, systolic blood pressure, heart rate, Scr, cardiac arrest at admission, elevated cardiac biomarkers, ST-segment deviation, and Killip class. [7]

In addition, the clinical endpoint of all-cause mortality in risk assessment models exhibits exceptional discriminatory capabilities [8]. According to the most recent recommendations, Within

24 hours, patients who have experienced a non-STEMI and have a GRACE risk score of 140 or higher should implement an early invasive strategy [9].

While various scoring systems, such as the TIMI and EuroSCORE, are commonly used for risk stratification in acute coronary syndromes, the GRACE score uniquely incorporates a wider range of clinical parameters, making it particularly effective in predicting in-hospital and long-term mortality across ACS presentations. This comprehensive approach justified its selection for our study. This study hypothesizes that GRACE-based risk stratification will provide valuable insights into mortality risk and patient outcomes following urgent CABG in NSTEMI patients, potentially enhancing stratification and management approaches in this high-risk group.

The purpose of this study is to assess the outcomes of emergent CABG following NSTEMI using the Global Registry of Acute Coronary Events (GRACE) score, with a particular focus on risk stratification.

## 2. Method

### 2.1.Study design and target group:

This is a retrospective study analyzing data from 60 consecutive NSTEMI patients who underwent urgent CABG.

The GRACE score was used to assess the mortality risk of 60 consecutive patients who underwent emergent CABG following a non-ST elevation myocardial infarction (NSTEMI). Patients were identified from a database containing prospectively collected data. Case notes were then retrospectively reviewed to confirm NSTEMI diagnoses in accordance with the European Society of Cardiology (ESC) guidelines.

The GRACE score, a widely used tool in ACS, stratifies mortality risk by integrating clinical parameters such as age, vital signs, and laboratory markers, providing valuable insights for guiding treatment decisions.

### 2.2. GRACE Score Calculation:

The standardized GRACE risk models, which are available online, were employed to determine the GRACE score and the anticipated mortality rate during hospitalization and at six months. '(https://www.mdcalc.com/calc/1099/grace-acs-risk-mortality-calculator ) [10].'

### 2.3. Risk Group Classification:

This structured approach to risk stratification using the GRACE score is crucial for identifying patients at higher risk of mortality following NSTEMI, to enable the implementation of customized

management strategies that enhance results. The GRACE prediction of the percentage risk of mortality at six months was used to categorize patients into three risk groups:

Risk Group 1: Low (<10% mortality)

The second group is classified as: intermediate risk. (10–19% mortality)

Group three: High-risk (≥20% mortality)

**2.4. Study methods:**

All CABG procedures were performed within 30 days of the initial hospital admission and were scheduled after a minimum of 24 hours post-admission. All patients kept taking aspirin until the day before surgery, in spite of the fact that clopidogrel was discontinued at least five days in advance. Before the operation, At the operation team's discretion, Intra-aortic balloon pumps were administered to patients who experienced persistent angina symptoms or had extensive left main stem disease. All interventions were performed using cardiopulmonary bypasse to protect the heart, there was authorization for the operating surgeon to administer intermittent antegrade warm or cold blood cardioplegia. Anesthetic and postoperative care were conducted in accordance with departmental protocols.

**2.6. Data Management**

Data management and statistical analysis were done using SPSS version 26 (IBM, Armonk, New York, United States). The numerical data were displayed in terms of their mean and standard deviation (SD). However, in both percentages and numerical formats, categorical data was presented. The chi-square test is employed. The differences between the categories were determined, when appropriate, Fisher exact, and on-the-fly ANOVA experiments. 0.05 was the acceptable level of significance.

**Results**

Group 3 exhibited significantly lower EF, suggesting increased ventricular dysfunction, which is often associated with higher mortality risk in CABG patients (p=0.026)." Also, EuroSCORE was significantly low among group 3 (p=0.034). **Table 1**

Table 2 It is confirmed that the cross-clamp time of group 3 was 56.7±9.6, This was significantly longer than the other two categories (p=0.032).

Table 3 exhibits that non-significant difference between the 3 groups regarding post-operative complications

## 3. Discussion

The findings of this study highlight the implications of urgent coronary artery bypass grafting (CABG) in managing non-ST elevation myocardial infarction (NSTEMI). They underscore the complexities in treating NSTEMI patients, particularly regarding the timing of revascularization and the use of the GRACE score for risk stratification.

Our results support the notion that urgent CABG can be a lifesaving intervention for NSTEMI patients, especially those with multivessel disease. Prior research, including studies by Ram et al., has shown that timely surgical revascularization reduces the incidence of adverse cardiac events and improves survival rates in non-STEMI patients [11]. Rojas et al. also found comparable mortality rates between early and delayed CABG, underscoring the benefits of early intervention [1]. Given that NSTEMI is often associated with significant coronary artery disease, delaying treatment can lead to severe ischemic complications.

The GRACE score's utility in clinical decision-making is evidenced by its reliable prediction of both in-hospital mortality and long-term outcomes for acute coronary syndrome (ACS) patients [12]. In line with current recommendations for high-risk NSTEMI patients, we categorized patients into low-, intermediate-, and high-risk groups to facilitate tailored treatment plans [9].

Our findings showed that Group 3 (high-risk) patients had significantly lower ejection fractions (EF) and Euro Scores compared to Groups 1 and 2, consistent with studies linking low EF to adverse post-CABG outcomes [1314].

Further, Senanayake et al. demonstrated that EuroSCORE predicted a higher preoperative risk for patients in the higher GRACE score risk groups [15], reinforcing the need for meticulous preoperative evaluation in this population. The EuroSCORE remains an essential tool for assessing surgical risk, and its correlation with adverse outcomes in high-risk patients emphasizes the importance of careful planning.

A notable finding was the longer cross-clamp time in Group 3, as prolonged ischemia during surgery can increase postoperative complications. This observation aligns with Ruggieri et al., who reported that extended cross-clamp times negatively impact postoperative recovery [16]. Shultz et al. similarly noted an association between prolonged cross-clamp times and adverse clinical outcomes [17]. Thus, while urgent CABG is crucial for high-risk patients, minimizing ischemic time may be essential to enhance recovery.

Our study also observed a higher in-hospital mortality rate in Group 3, despite no significant differences in the overall incidence of postoperative complications among the groups. This outcome aligns with studies demonstrating the GRACE score's strong predictive precision for in-hospital mortality, with a C statistic ranging from 0.842 to 0.923 [18]. While the GRACE score effectively predicts mortality, it may not always correlate with postoperative complications, suggesting that mortality in high-GRACE patients could be influenced by factors beyond surgical complications. The relatively low postoperative complication rates across risk groups suggest that, with appropriate surgical and perioperative management, even high-risk patients can achieve favorable outcomes. This highlights the importance of a multidisciplinary approach, involving cardiologists, surgeons, and critical care teams, to optimize perioperative care for NSTEMI patients [18].

Despite these valuable insights, several limitations must be acknowledged. The retrospective design and small sample size may limit the generalizability of the results and introduce selection bias. Additionally, the single-center nature of the study may not fully reflect the diverse practices seen in different healthcare settings. Further multicenter studies with larger populations are needed to validate these findings and improve CABG outcomes in NSTEMI patients.

## 4. Conclusion

In conclusion, our study highlights the critical role of urgent CABG in managing NSTEMI patients, particularly those identified as high-risk via the GRACE score. The findings emphasize the need for timely intervention, tailored management strategies, and ongoing research to optimize outcomes in this vulnerable patient population. As the landscape of cardiac surgery continues to evolve, our insights contribute to the ongoing dialogue surrounding the best practices for treating NSTEMI and improving patient care.

## Disclaimer (Artificial intelligence)

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**Consent**

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

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**Table 1: Pre-operative demographics**

| Parameters | | Group 1 (no=43) | Group 2 (no=10) | Group 3 (no=7) | p-value |
|---|---|---|---|---|---|
| Age, Mean ± SD | | 66.3±7.8 | 60.3±7.2 | 64.6±11.5 | 0.121 |
| Gender | Male | 25 (58.1) | 5 (50.0) | 4 (57.1) | 0.916 |
| | Female | 18 (41.9) | 5 (50.0) | 3 (42.9) | |
| CCS, no (%) | Class I | 14 (32.6) | 6 (60.0) | 2 (28.6) | 0.256 |
| | Class II | 10 (23.3) | 0 (0.0) | 3 (42.9) | |
| | Class III | 13 (30.2) | 4 (40.0) | 1 (14.3) | |
| | Class IV | 6 (14.0) | 0 (0.0) | 1 (14.3) | |
| | Class I | 12 (27.9) | 1 (10.0) | 4 (57.1) | 0.225 |

| | | | | | |
|---|---|---|---|---|---|
| NYHA, no (%) | Class II | 11 (25.6) | 3 (30.0) | 3 (42.9) | |
| | Class III | 13 (30.2) | 3 (30.0) | 0 (0.0) | |
| | Class IV | 7 (16.3) | 3 (30.0) | 0 (0.0) | |
| Previous MI, no (%) | | 14 (32.6) | 4 (40.0) | 4 (57.1) | 0.488 |
| DM, no (%) | | 21 (48.8) | 3 (30.0) | 4 (57.1) | 0.509 |
| COPD/Asthma, no (%) | | 12 (27.9) | 2 (20.0) | 0 (0.0) | 0.235 |
| Triple vessels disease, no (%) | | 10 (23.3) | 4 (40.0) | 2 (28.6) | 0.643 |
| LMS disease, no (%) | | 21 (48.8) | 6 (60.0) | 5 (71.4) | 0.554 |
| Ejection fraction, Mean ± SD | | 47.4±11.2 | 45.7±12.7 | 34.1±12.6 | **0.026*** |
| EuroSCORE, Mean ± SD | | 9.0±3.8 | 8.0±3.8 | 6.3±3.0 | **0.034*** |

**Indicates significant p-value at 0.05*

**Table 2: Operative characteristics**

| Parameters | Group 1 (no=43) | Group 2 (no=10) | Group 3 (no=7) | p-value |
|---|---|---|---|---|
| CPB time, Mean ± SD | 103.72±14.8 | 104.2±15.3 | 112.6±20.1 | 0.377 |
| Cross-clamp time, Mean ± SD | 41.9±13.5 | 44.2±15.4 | 56.7±9.6 | **0.032*** |
| No. distal grafts ≥3, no (%) | 20 (46.5) | 6 (60.0) | 6 (85.7) | 0.129 |

**Indicates significant p-value at 0.05*

**Table 3: Post-operative complications by GRACE risk group**

| Parameters | Group 1 (no=43) | Group 2 (no=10) | Group 3 (no=7) | p-value |
|---|---|---|---|---|
| In-hospital mortality, no (%) | 3 (7.0) | 0 (0.0) | 2 (28.6) | 0.093 |
| Episode of LCOS, no (%) | 22 (51.2) | 7 (70.0) | 4 (57.1) | 0.550 |

| | | | | |
|---|---|---|---|---|
| Arrhythmias, no (%) | 19 (44.2) | 5 (50.0) | 3 (42.9) | 1.0 |
| Re-operation | 18 (41.9) | 4 (40.0) | 6 (85.7) | 0.106 |
| Hours ventilated, Mean ± SD | 16.2±6.2 | 17.5±6.0 | 21.4±5.3 | 0.112 |
| Respiratory complications | 5 (11.6) | 1 (10.0) | 1 (14.3) | 1.0 |
| Post-operative Stroke, no (%) | 1 (2.3) | 1 (10.0) | 1 (14.3) | 0.191 |
| Cr >200 μmol/l, no (%) | 13 (30.2) | 6 (60.0) | 2 (28.6) | 0.231 |
| CVVH, no (%) | 2 (4.7) | 1 (10.0) | 1 (14.3) | 0.747 |

*LCOS: low cardiac output syndrome, Cr=creatinine; CVVH: continuous veno-venous hemofiltration.*