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Early versus late surgical revascularization after acute myocardial infarction

Ashraf Elnahas[1], Mohamed Saffan[1], Moataz Rezk[1], Mohammed Rostom[2]

[1] Department of Cardiothoracic Surgery, Faculty of Medicine, Banha University, Banha, Egypt

[2] Cardiothoracic Surgery, Luxor International Medical Complex, Egypt Healthcare Authority, Luxor, Egypt

Abstract

Background: Optimal timing for coronary artery bypass grafting (CABG) after acute myocardial infarction (AMI) remains contentious. Early surgical intervention may minimize myocardial damage but carries increased risks, while delayed surgery allows myocardial stabilization but may lead to recurrent ischemic events.Our objectives is to compare early (0-3 days post-AMI) versus late (4-30 days post-AMI) surgical revascularization outcomes, focusing on mortality and postoperative complications.

Methods: This prospective cohort comparative study was conducted from June 2023 to May 2024 at three centers in Egypt. Sixty patients (mean age 55.67 ± 9.05 years; 85% male) undergoing CABG within 30 days of AMI were enrolled. Patients were divided into two groups based on timing: Early CABG (0–3 days post-AMI, n=30) and Late CABG (4–30 days post-AMI, n=30). Preoperative, intraoperative, and postoperative data were collected. Outcomes were assessed during hospitalization and at follow-up (mean duration 8.1 ± 1.73 months).

Results: Baseline demographic, angiographic, and echocardiographic characteristics were comparable between groups. The early CABG group showed significantly more akinetic/dyskinetic apical wall motion abnormalities (p = 0.001). In-hospital mortality was higher in the early group though without a significant difference (13.3% vs. 3.3%, p = 0.16). Postoperative complications were significantly more frequent in the early CABG group (33.3% vs. 10%, p = 0.02). The durations of ICU stay (3.83±1.36 vs. 2.37±1.71 days, p = 0.001) and total hospital stay (9.33±3.29 vs. 6.83±3.05 days, p = 0.003) were significantly longer in early CABG. Odds of complications were 4.5 times higher in early CABG while mortality odds showed a non-significant trend toward increase.

Conclusion: Early CABG may be associated with increased postoperative complications, necessitating careful patient selection and perioperative management. Delayed CABG allows for myocardial stabilization, potentially reducing perioperative risks.

KEYWORDS
Coronary artery bypass grafting; Myocardial infarction; STEMI

Introduction

Coronary artery bypass grafting (CABG) remains a cornerstone in the management of coronary artery disease (CAD), particularly in patients presenting with acute myocardial infarction (AMI). Despite advances in interventional cardiology, surgical revascularization continues to play a critical role in

Corresponding author: Mohammed Rostom rafatrostom@gmail.com

cases involving failed percutaneous coronary intervention (PCI), unsuitable coronary anatomy, or hemodynamic instability [1, 2].

The optimal timing of CABG after AMI remains a subject of clinical uncertainty. Early CABG may be necessary in patients with ongoing ischemia or failed percutaneous coronary intervention; however, this period is also associated with increased myocardial vulnerability, heightened inflammatory response, and greater risk of perioperative complications, including cardiac rupture and bleeding [3].

In stable patients, early CABG may carry increased risks but it could be offset by benefits such as enhanced cardiac remodeling, improved quality of life, and reduced hospital stay and associated costs [4]. On the other hand, delaying surgery beyond 3–7 days allows for myocardial stabilization [5, 6], but may expose patients to prolonged ischemia or recurrent infarction [7].

Existing studies report conflicting outcomes regarding mortality and morbidity associated with early versus delayed CABG, and there is no universally accepted guideline for optimal timing [7-10]. Given the lack of consensus on an ideal cut-off time point that can determines the outcome of CABG after AMI, this study aims to preliminarily evaluate differences in outcomes between early (0-3 days) and late (4-30 days) CABG to inform future definitive research and guide clinical decision-making.

Patients and Methods

Study Design and Population:

This exploratory study was designed as prospective cohort comparative study. It was conducted from June 2023 to May 2024 at three different centres. Sixty patients who underwent CABG within 30 days following acute myocardial infarction (AMI) were included in the study, with a mean age of 55.67 ± 9.05 years (range: 32–73 years) and a predominance of males (51 out of 60; 85%). The cohort was divided into two groups according to timing of CABG. In group A (Early CABG, n=30) CABG was performed within 0-3 days post-AMI, while group B (Late CABG, n=30) included patients who underwent CABG within 4-30 days post-AMI.

Defining early CABG within 0-3 days after AMI is based on clinical reasoning and prior evidence, considering myocardial vulnerability, systematic inflammatory response and hemodynamic instability within the first 72 hours post-MI. The classification of post-MI CABG as early (0-3 days) and late (4-30 days) is supported by evidence from previous studies which used 3 days as a cut-off point for CABG timing after AMI [11-13].

Inclusion Criteria:

- Isolated CABG for failed PCI or unsuitable coronary anatomy.
- Persistent ischemia refractory to medical therapy.
- Left main coronary artery disease, cardiogenic shock, or life-threatening arrhythmias.

Exclusion Criteria:

- Redo-CABG or concomitant cardiac procedures.
- Severe renal or hepatic dysfunction.

Sample size:

The sample size was chosen pragmatically due to exploratory nature of the study. The sample size was not determined based on formal power calculations. It was determined by the availability of eligible cases during the study period. A total of 60 patients (30 in each group) were enrolled to allow preliminary evaluation of outcome difference, assess feasibility, and generate effect size estimates to guide sample size calculations for future confirmatory studies.

Data Collection:

Preoperative, intraoperative, and postoperative data were recorded, including demographics, comorbidities, echocardiographic findings, operative duration, and complications. On discharge, protective cardiovascular medications including Aspirin, Beta-blockers, and diuretics were prescribed for all survivor patients. Postoperative outcomes were assessed at discharge and during follow-up at 1, 3, and 6 months. Mean duration of follow-up after discharge to home was 8.1±1.73 months (range, 6-12 months). All survivors completed 6 months of follow-up.

Table 1: Preoperative demographic and clinical characteristics. Categorical data are expressed as number (%). Continuous data are expressed as mean ± standard deviation

Variables	Early CABG (n=30)	Late CABG (n=30)	P-value
Age (years)	55.13±9.17	56.20±9.06	0.65
Gender:			
Male	23 (76.7%)	28 (93.3%)	0.07
Female	7 (23.3%)	2 (6.7%)	
Weight (kg)	81±12.28	83.3±15.3	0.53
Height (cm)	165.9±9.70	167.3±9.41	0.57
BMI (kg/m^2)	29.58±4.68	29.77±4.99	0.87
BSA	1.86±0.18	1.90±0.21	0.47
Smoking	9 (30%)	16 (53.3%)	0.11
DM	20(66.7%)	21 (70%)	0.78
IDDM	7 (23.3%)	3 (10%)	0.16
Hypertension	20 (66.7%)	18 (60%)	0.59
Hypercholesterolaemia	14 (46.7%)	15 (50%)	0.79
Cerebrovascular accident	1 (3.3%)	1 (3.3%)	1
Peripheral vascular disease	0 (0%)	1 (3.3%)	0.31
CHF	3 (10%)	5 (16.7%)	0.44
Previous MI	5 (16.7%)	4 (13.3%)	0.71
Arrhythmia	0 (0%)	1 (3.3%)	0.31
Previous PCI	3 (10%)	4 (13.3%)	0.68
Critical status	2 (6.7%)	0 (0%)	0.15
Intravenous Nitrates	2 (6.7%)	0 (0%)	0.15
Intravenous inotropes	2 (6.7%)	0 (0%)	0.15
Preoperative IABP	2 (6.7%)	0 (0%)	0.15
Operation priority:			
Elective	26 (86.7%)	29 (96.7%)	0.16
Emergency	4 (13.3%)	1 (3.3%)	
Preoperative medications:			
Beta-blockers	22 (73.3%)	25 (83.3%)	0.34
ACE inhibitors	12 (40%)	10 (33.3%)	0.59
Lipid lowering agents	13 (43.3%)	15 (50%)	0.60
Calcium channel blockers	3 (10%)	1 (3.3%)	0.30
Oral Nitrates	15 (50%)	11 (36.7%)	0.29
Antiplatelets	5 (16.7%)	3 (10%)	0.44

BMI: Body mass index., BSA: Basal surface area. DM: Diabetes mellitus, IDDM: Insulin-dependent diabetes mellitus, CHF: Congestive heart failure, MI: Myocardial infarction., PCI: Percutaneous coronary intervention. IABP: Intra-aortic balloon pump

Definitions:

Postoperative outcomes following CABG were defined using the standard criteria of the Society of Thoracic Surgeons (STS). Myocardial infarction is identified by clinical, enzymatic, or electrocardiographic evidence of cardiac injury. In-hospital mortality refers to death occurring during the same hospitalization or within 30 days of surgery. Reoperation indicates a return to the operating room for issues such as bleeding, graft complications, or wound problems. Stroke is characterized by a new, permanent focal neurologic deficit confirmed by clinical assessment and imaging. Renal failure is defined as the need for new dialysis or a significant deterioration in kidney function postoperatively. New-onset atrial fibrillation or flutter refers to arrhythmias requiring therapeutic intervention in patients with no prior history. Deep sternal wound infection, or mediastinitis, involves infection of the sternum requiring treatment and often surgical intervention. Pneumonia is diagnosed based on new pulmonary infiltrates accompanied by clinical signs of infection and microbiologic confirmation.

Table 2: Comparing preoperative extent of coronary artery disease (CAD) between both groups. Categorical data are expressed as number (%)

Variables	Early CABG (n=30)	Late CABG (n=30)	P-value
Single vessel disease	1(3.3%)	2(6.7%)	0.55
Double vessel disease	3(10%)	1(3.3%)	0.30
Triple vessel disease	26(86.7%)	27(90%)	0.68
LMS disease	2(6.7%)	1(3.3%)	0.55

LMS: Left main stem

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation and compared using the T-test, whereas categorical variables were reported as counts and percentages and analyzed using the Chi-square test. The effect size was estimated based on binary outcome (mortality rates and overall rate of postoperative complications). Odds ratio (OR) and its 95% confidence interval (95%CI) were estimated as preliminary effect sizes. Significance was set at p<0.05.

Results

Preoperative characteristics:

Preoperative demographic and clinical characteristics were comparable between both groups (Table 1). There was no significant difference in age, weight, height, BMI, and BSA were similar between groups (p > 0.05). Also, the incidences of diabetes mellitus (both general and insulin-dependent), hypertension, hypercholesterolemia, smoking, cerebrovascular accident, peripheral vascular disease, and previous myocardial infarction were statistically comparable across both groups (p > 0.05). There was a trend toward more patients in the early CABG group requiring intravenous nitrates, inotropes, IABP support, and presenting in a critical status, but these differences were not statistically significant. Preoperative use of medications such as beta-blockers, ACE inhibitors, lipid-lowering agents, oral nitrates, and antiplatelets was similar in both groups (p > 0.05). A slightly higher proportion of emergency cases was observed in the early CABG group (13.3% vs. 3.3%), although this difference was also not statistically significant (p = 0.16).

Angiographic extent of coronary artery disease:

Preoperative angiographic findings suggest that the severity and distribution of CAD were comparable between the early and late CABG groups (Table 2). The high incidence of triple vessel disease across both groups underscores the complexity of patients selected for surgical revascularization after AMI.

Table 3: Comparing preoperative echocardiographic data between both groups. Categorical data are expressed as number (%). Continuous data are expressed as mean ± standard deviation

Variables	Early CABG (n=30)	Late CABG (n=30)	P-value
Low LVEF	9(30%)	8(26.7%)	0.77
LVEF (%)	53.56±8.47	53.86±7.31	0.88
LVEDD (cm)	4.86±0.48	4.80±0.58	0.70
LVESD (cm)	3.28±0.44	3.32±0.48	0.69
Apical contraction:			
Hypokinesia	3(10%)	17(56.7%)	
Akinesia	18(60%)	9(30%)	0.001*
Dyskinesia	9(30%)	4(13.3%)	

LVEF: Left ventricular ejection fraction, LVEDD: Left ventricular end-diastolic diameter, LVESD: Left ventricular end-systolic diameter.
*Significant difference

Table 4: Operative data. Categorical data are expressed as number (%). Continuous data are expressed as mean ± standard deviation

Variables	Early CABG (n=30)	Late CABG (n=30)	P-value
Bypass time (min)	88.20±37	96.17±41	0.43
Cross-clamp time (min)	58.97±32.18	59.87±27.98	0.90
Number of distal anastomoses	2.30±0.83	2.53±0.90	0.30
Graft conduit:			
LIMA	27(90%)	28(93.3%)	0.64
Long SV	1(3.3%)	2(6.7%)	0.55
Radial artery	2(6.7%)	0(0%)	0.15
Quality of coronary arteries:			
Good	24(80%)	26(86.7%)	0.48
Poor	6(20%)	4(13.3%)	
Local procedures:			
Vein patch	9(30%)	1(3.3%)	0.006*
Routine CABG	21(70%)	29(96.7%)	
Intraoperative blood transfusion	5(16.7%)	2(6.7%)	0.22
Intraoperative IABP	1(3.3%)	0(0%)	0.31

LIMA: Left internal mammary artery, SV: Saphenous vein, IABP: Intra-aortic balloon pump.
*Significant difference

Preoperative echocardiographic data:

Comparing the key echocardiographic parameters between patients undergoing early versus late CABG (Table 3) revealed no significant difference in mean left ventricular ejection fraction (LVEF) values (53.56% ± 8.47 vs. 53.86% ± 7.31; p = 0.88), proportion of patients with low LVEF (30% vs. 26.7%; p = 0.77), mean left ventricular end-diastolic diameter (LVEDD) (4.86 ± 0.48 cm vs. 4.80 ± 0.58 cm; p = 0.70) and left ventricular end-systolic diameter (LVESD) (3.28 ± 0.44 cm vs. 3.32 ± 0.48; p = 0.69). The early CABG group had more advanced or severe localized contractile impairment (akinesia/dyskinesia), while the late group exhibited more moderate dysfunction (hypokinesia) with a statistically significant difference (p = 0.001) indicating more acute and severe ischemic injury in the early cohort and possibly justifying the urgency of intervention.

Operative data:

The operative techniques and overall surgical complexity were largely comparable between early and late CABG groups (Table 4). The mean bypass time and aortic cross-clamp time were slightly longer in the late CABG group (96.17 ± 41 vs. 88.20 ± 37 min and 59.87 ± 27.98 vs. 58.97 ± 32.18 min, respectively), but the differences were not statistically significant (p >0.05). The mean number of distal anastomosis was slightly higher in the late CABG group (2.53 vs. 2.30), but without statistical significance (p > 0.05). Use of long saphenous vein (SV) and radial artery conduits did not differ significantly (p > 0.05). A significant difference was observed in the use of vein patching, which was much more common in the early CABG group (30% vs. 3.3%, p = 0.006). This may reflect more friable or inflamed coronary arteries in the early group. Use of intraoperative intra-aortic balloon pump (IABP) and blood transfusions was slightly more frequent in the early CABG group, though not statistically significant.

Postoperative outcome:

Postoperative outcomes and durations are presented in (Table 5). In-hospital mortality was higher in the early CABG group (13.3% vs. 3.3%), but the difference did not reach statistical significance (p = 0.16). Overall postoperative complications were significantly more common in the early CABG group (33.3% vs. 10%, p = 0.02). Low cardiac output, need for blood transfusion, and pulmonary/ neurological/ infective complications were more frequent in the early group, but none reached statistical significance (p-values > 0.05). Reoperation for bleeding occurred in 23.3% of early CABG patients compared to only 6.7% in the late group (p = 0.07). Although not

Table 5: Postoperative outcomes and durations. Categorical data are expressed as number (%). Continuous data are expressed as mean ± standard deviation

Variables	Early CABG (n=30)	Late CABG (n=30)	P-value
In-hospital mortality	4(13.3%)	1(3.3%)	0.16
Postoperative complications (overall)	10(33.3%)	3(10%)	0.02*
Low cardiac output	12(40%)	10(33.3%)	0.59
Blood transfusion	24(80%)	22(73.3%)	0.54
Reoperation for bleeding	7(23.3%)	2(6.7%)	0.07
Postoperative arrhythmia	1(3.3%)	0(0%)	0.31
Pulmonary complications	2(6.7%)	1(3.3%)	0.55
Neurological complications	1(3.3%)	0(0%)	0.31
Infective complications	1(3.3%)	0(0%)	0.31
Postoperative durations:			
Ventilation (hours)	16.87±11.19	15.03±17.36	0.62
ICU stay (days)	3.83±1.36	2.37±1.71	0.001*
Hospital stay (days)	9.33±3.29	6.83±3.05	0.003*

*Significant difference

statistically significant, this represents a notable trend and may reflect increased surgical complexity or instability in the early period. Postoperative arrhythmia occurred only in the early group (3.3%), though rare and not significant.

The duration of ICU stay was significantly longer in the early CABG group (3.83 ± 1.36 days vs. 2.37 ± 1.71 days, p = 0.001). Hospital stay was also significantly prolonged in the early group (9.33 ± 3.29 vs. 6.83 ± 3.05 days, p = 0.003). Ventilation time was slightly longer in early CABG (16.87 ± 11.19 vs. 15.03 ± 17.36 hours), but the difference was not statistically significant (p = 0.62).

Table 6: Analysis of the effect size (Odds ratio and 95% confidence interval) of early CABG for in-hospital mortality and postoperative complications

Variables	OR	95% CI Upper limit	95% CI Lower limit
In-hospital mortality	4.46	0.47	42.52
Postoperative complications (overall)	4.50	1.09	18.50

OR: Odds ratio; CI: Confidence interval
*Significant difference

The analysis of effect size (Table 6) highlights that early CABG may increase the risk of postoperative complications significantly, while its effect on mortality remains uncertain but potentially important. The odds of in-hospital mortality were over four times higher in the early CABG group compared to late CABG. However, the wide confidence interval and its inclusion of 1 indicate statistical non-significance and high uncertainty. The result suggests a potential but inconclusive risk increase with early surgery. Patients in the early CABG group had 4.5 times higher odds of developing postoperative complications compared to those undergoing late CABG. The confidence interval does not include 1 and the lower bound is above 1.09, indicating a statistically significant and clinically relevant effect.

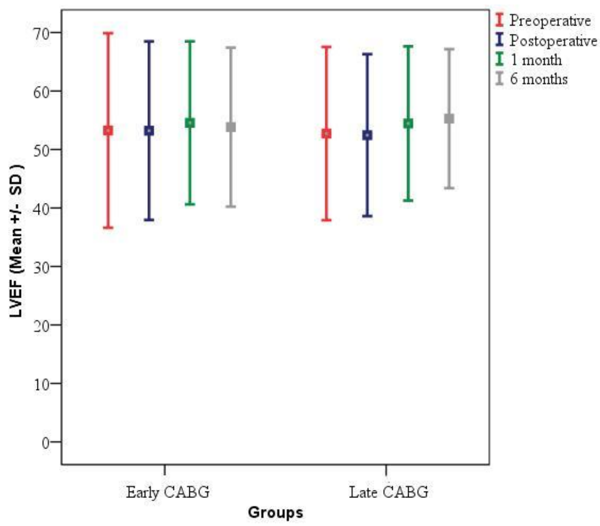

Figure 1: Error bars chart showing mean +/- standard deviation (SD) of left ventricular ejection fraction (LVEF)

Table 7: Comparing postoperative LVEF (%) in survivors between early and late CABG groups. Continuous data are expressed as mean ± standard deviation

Variables	Early CABG (n=26)	Late CABG (n=29)	P-value
Immediate postoperative	53.57±7.63	53.72±6.92	0.94
1-month	54.19±6.80	55.72±6.59	0.40
6-months	54.92±6.96	56.55±5.94	0.35

LVEF: Left ventricular ejection fraction; Mann-Whitney U test was used for comparisons

Postoperative and follow-up LVEF in survivors:

Comparing postoperative LVEF in survivors between early and late CABG groups (Table 7 and Figure 1) showed no significant difference between both groups at immediate postoperative period, 1-month, and 6-months ($p > 0.05$) with a significant improvement from baseline LVEF in both groups at 6-months ($p < 0.05$).

Discussion

The main finding of this exploratory study is that patients undergoing early CABG within first 3 days after AMI experienced significantly more postoperative morbidity and prolonged recovery, although the impact of early CABG on in-hospital mortality remains uncertain.

In literature, the timing of CABG after AMI and the associated risks vary based on clinical and demographic factors. Higher surgical risks have been linked to advanced age, female sex, and heart failure at presentation. Understanding these variations is essential, especially when comparing patients admitted with AMI requiring urgent intervention versus those undergoing elective CABG following initial PCI stabilization [14].

Early CABG following AMI is associated with increased operative and postoperative complications, with reported mortality rates ranging from 3.6% to 42.9%. However, advancements in mechanical circulatory support and myocardial protection have improved surgical outcomes, even in high-risk scenarios such as cardiogenic shock. Elective CABG, performed after initial stabilization, is associated with significantly lower risk compared to emergency revascularization during AMI [15].

Baseline demographic and clinical characteristics did not significantly differ between the two groups, consistent with findings by Fakhry et al. [13], who also reported no significant differences in a cohort had CABG before or after 3 days post-MI. Similarly, Khan et al. [16], in a study of 184 STEMI patients, found no significant differences in baseline characteristics between early (within 24 hours) and late (after 24 hours) CABG groups.

Preoperative comorbidities, known to impact surgical risk, were also comparable across the two groups in the present study. These results align with Bianco et al. [14], who reported no significant differences in dyslipidemia, diabetes, hypertension, or chronic lung disease between early (<24 hours) and late (≥24 hours) CABG patients. Conversely, Arora et al. [17] found a higher prevalence of smoking in the early group and increased rates of diabetes and chronic kidney disease in the late group.

The significantly higher incidence of akinetic and dyskinetic apical wall motion abnormalities in the early CABG group may reflect more extensive myocardial injury or delayed recovery of stunned myocardium following acute ischemic events [18]. This finding suggests that patients selected for early surgery could have had more severe or extensive infarction at baseline, potentially contributing to the observed increase in postoperative complications and prolonged recovery times. It also underscores the need for careful preoperative assessment of ventricular function when considering early surgical intervention.

There was no significant difference in preoperative LVEF and left ventricular dimensions between early and late CABG groups. These findings are consistent with Bianco et al. [14], who found no differences in LVEF between groups.

However, other studies, including those by Nichols et al. [19] and Abd-Alaal et al. [20] reported lower ejection fractions in early CABG patients.

We found that the use of intra-aortic balloon pump (IABP) was slightly more frequent in the early CABG group, though not statistically significant. Fakhry et al. [13] reported an association of early CABG with STEMI and hemodynamic instability, as did Weiss et al. [11] and Nichols et al. [19], who noted higher use of intra-aortic balloon pumps (IABP) and cardiogenic shock in early CABG cases. Bárta et al. [21] reported that 3.2% of unstable patients required early CABG, often due to preoperative IABP use, cardiogenic shock, or mechanical ventilation, all of which increased operative risk. Similarly, Arora et al. [17] observed that early interventions were more commonly associated with ST-segment deviation and cardiogenic shock.

In our study, early CABG associated with longer ICU and hospital stays. Similarly, Fakhry et al. [13] also reported significantly longer ICU stays in early CABG patients, while hospital stays remained comparable. The association between early CABG and longer ICU and hospital stays in our study likely reflects the increased perioperative complexity and higher incidence of postoperative complications observed in this group. Early surgical intervention, particularly in the setting of acute coronary syndrome, may involve patients who are hemodynamically unstable or have ongoing myocardial injury, both of which can contribute to a more challenging recovery. These findings emphasize the need to balance the urgency of revascularization with the patient's clinical stability to optimize postoperative outcomes and resource utilization.

Postoperatively, early CABG was associated with a higher overall complication rate but there was no significant difference in the incidence of each complication separately. These results are consistent with the findings of Fakhry et al. [13] and Nichols et al. [19]. However, Abd-Alaal et al. [20] and Creswell et al. [22] reported higher rates of arrhythmia in early CABG patients.

We did not find a significant difference in the rate of in-hospital mortality between early and late CABG. Despite variation in mortality across studies, most evidence suggests that early CABG is associated with increased mortality, likely driven by preoperative risk factors such as low ejection fraction, STEMI, arrhythmias, IABP use, and cardiogenic shock [13].

Weiss et al. [11] found a significantly higher mortality rate for early CABG (5.6% vs. 3.8%, P=0.001), with risk doubling if surgery was performed within the first three days post-MI. Sintek et al. [23] found no significant association between surgery timing and mortality but noted higher wound infection rates in patients undergoing CABG 4–7 days post-MI. Parikh et al. [24] also found no difference in survival for CABG within versus after 48 hours. Khan et al. [16] found no significant differences in one-month or one-year mortality between STEMI patients who underwent CABG within or after 24 hours. Moreover, Khaladj et al. [25] reported higher 30-day mortality in STEMI than NSTEMI patients.

The finding of a non-significant difference in mortality between early and delayed coronary artery bypass grafting (CABG) following acute myocardial infarction (AMI) warrants careful interpretation. While the lack of a statistically significant mortality difference may suggest that early surgical intervention is not inherently life-threatening, the associated increase in perioperative complications observed in the early CABG group cannot be overlooked. These complications—ranging from arrhythmias, bleeding, low cardiac output syndrome, to prolonged mechanical ventilation—can contribute to increased postoperative morbidity, extended intensive care unit and hospital stays, higher healthcare costs, and impaired functional recovery.

Clinically, this raises important concerns regarding the optimal timing of surgical intervention. It suggests that although early CABG may be safe from a mortality standpoint, the heightened risk of complications may undermine the overall benefits of early revascularization, especially in hemodynamically stable patients.

Consequently, these findings underscore the importance of a patient-centered, multidisciplinary approach to timing decisions, weighing the urgency of revascularization against the potential risk of adverse outcomes. Future studies with larger sample sizes are needed to better define the subgroups of patients who may benefit most from early intervention while minimizing complications.

Limitations

This prospective multicenter observational study offers useful insights into the timing of surgical revascularization following acute myocardial infarction. Strengths include a relevant clinical objective, well-matched comparison groups, and focus on key perioperative outcomes. However, the study has potential limitations including small sample size, short-term follow-up, observational design, exploratory nature, and limited statistical power which could temper the generalizability of the study conclusions.

Conclusion

In conclusion, although early surgical intervention after AMI may be feasible in selected patients, it may carry a greater burden of postoperative morbidity. Given the small sample size and observational design, the results should be interpreted with caution. Further large-scale, randomized studies are warranted to confirm these preliminary observations and to refine clinical decision-making regarding the optimal timing of CABG after AMI. Until such evidence is available, individualized risk assessment and multidisciplinary evaluation remain essential for guiding surgical timing in this clinically vulnerable group.

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References

1. Liakopoulos OJ, Slottosch I, Wendt D, et al. Surgical revascularization for acute coronary syndromes: a report from the North Rhine-Westphalia surgical myocardial infarction registry. Eur J Cardiothorac Surg. 2020; 58 (6): 1137-44.
2. Sandner S, Florian A, Ruel M. Coronary artery bypass grafting in acute coronary syndromes: modern indications and approaches. Curr Opin Cardiol. 2024; 39 (6): 485-90.
3. Lang Q, Qin C, Meng W. Appropriate Timing of Coronary Artery Bypass Graft Surgery for Acute Myocardial Infarction Patients: A Meta-Analysis. Front Cardiovasc Med. 2022;9:1-10.
4. Raghavan R, Benzaquen BS, Rudski L. Timing of bypass surgery in stable patients after acute myocardial infarction. Can J Cardiol. 2007; 23 (12): 976-82
5. Crossman AW, D'Agostino HJ Jr, Geraci SA. Timing of coronary artery bypass graft surgery following acute myocardial infarction: a critical literature review. Clin Cardiol. 2002;25(9):406-10.
6. Raghavan R, Benzaquen BS, Rudski L. Timing of bypass surgery in stable patients after acute myocardial infarction. Can J Cardiol. 2007; 23 (12): 976-82.
7. Patlolla SH, Crestanello JA, Schaff HV, et al. Timing of coronary artery bypass grafting after myocardial infarction influences late survival. JTCVS Open. 2024;20:40-8.
8. Lemaire A, Vagaonescu T, Ikegami H, Volk L, Verghis N, Lee LY. Delay in coronary artery bypass grafting for STEMI patients improves hospital morbidity and mortality. J Cardiothorac Surg. 2020; 15 (1): 86.
9. Bernard C, Morgant MC, Jazayeri A, et al. Optimal Timing of Coronary Artery Bypass Grafting in Haemodynamically Stable Patients after Myocardial Infarction. Biomedicines. 2023;11(3):1-10.
10. Kim HH, Lee M, Yoo KJ. Optimal Revascularization Timing of Coronary Artery Bypass Grafting in Acute Myocardial Infarction. Clin Cardiol. 2024;47(8):1-9.
11. Weiss ES, Chang DD, Joyce DL, Nwakanma LU, Yuh DD. Optimal timing of coronary artery bypass after acute myocardial infarction: a review of California discharge data. J Thorac Cardiovasc Surg. 2008; 135: 503–11.
12. Davierwala PM, Verevkin A, Leontyev S, Misfeld M, Borger MA, Mohr FW. Does timing of coronary artery bypass surgery affect early and long-term outcomes in patients with non-ST-segment-elevation myocardial infarction? Circulation. 2015;132:731–40.

13. Fakhry A, Balbaa Y, AboSenna WG, Saleh HZ. Timing of coronary artery bypass grafting surgery after acute myocardial infarction. Egypt Cardiothorac Surg. 2020;2(4):141–7.
14. Bianco V, Kilic A, Gleason TG, et al. Timing of coronary artery bypass grafting after acute myocardial infarction may not influence mortality and readmissions. J Thorac Cardiovasc Surg. 2021;161(6):2056-64.e4.
15. Acharya D. Predictors of Outcomes in Myocardial Infarction and Cardiogenic Shock. Cardiol Rev. 2018;26(5):255-66.
16. Khan AN, Sabbagh S, Ittaman S, et al. Outcome of early revascularization surgery in patients with ST-elevation myocardial infarction. J Interv Cardiol. 2015;28(1):14-23.
17. Arora S, Matsushita K, Qamar A, Stacey RB, Caughey MC. Early versus late percutaneous revascularization in patients hospitalized with non ST-segment elevation myocardial infarction: The atherosclerosis risk in communities surveillance study. Catheter Cardiovasc Interv. 2018;91(2):253-59.
18. Kloner RA. Stunned and Hibernating Myocardium: Where Are We Nearly 4 Decades Later? J Am Heart Assoc. 2020;9(3):1-11.
19. Nichols EL, McCullough JN, Ross CS, et al. Optimal Timing From Myocardial Infarction to Coronary Artery Bypass Grafting on Hospital Mortality. Ann Thorac Surg. 2017;103(1):162-71.
20. Abd-Alaal MM, Alsabban MA, Abbas OA, Alshaer AA, Al-Saddique A, Fouda M. Timing of revascularization after acute myocardial infarction. Asian Cardiovasc Thorac Ann. 2010;18(2):118-21.
21. Bárta J, Brát R, Gaj J, Kolek M, Novobílský K, Porzer M. Immediate coronary artery bypass graft surgery for acute coronary syndrome – Outcomes and trends over the past eight years. Cor Vasa. 2015;57(2):e63–e69.
22. Creswell LL, Moulton MJ, Cox JL, Rosenbloom M. Revascularization after acute myocardial infarction. Ann Thorac Surg. 1995;60(1):19-26.
23. Sintek CF, Pfeffer TA, Khonsari S. Surgical revascularization after acute myocardial infarction. Does timing make a difference? J Thorac Cardiovasc Surg. 1994;107(5):1317-21.
24. Parikh SV, de Lemos JA, Jessen ME, et al. Timing of in-hospital coronary artery bypass graft surgery for non-ST-segment elevation myocardial infarction patients results from the National Cardiovascular Data Registry ACTION Registry-GWTG (Acute Coronary Treatment and Intervention Outcomes Network Registry-Get With The Guidelines). JACC Cardiovasc Interv. 2010;3(4):419-27.
25. Khaladj N, Bobylev D, Peterss S, et al. Immediate surgical coronary revascularisation in patients presenting with acute myocardial infarction. J Cardiothorac Surg. 2013;8:1-7.