https://doi.org/10.29309/TPMJ/2024.31.03.7719

The Professional Medical Journal
www.theprofesional.com
2024, Volume, 31 Issue, 03

ORIGINAL ARTICLE

Timing of coronary artery bypass grafting in patients with myocardial infarction. Is the earlier the better?

Imran Khan[1], Muhammad Irfan[2], Fazila Khan[3], Abdelbasset El Refy[4], Zahid Khan[5], Yaqzan Obeidat[6]

Article Citation: Khan I, Irfan M, Khan F, Refy AE, Khan Z, Obeidat Y. Timing of coronary artery bypass grafting in patients with myocardial infarction. Is the earlier the better? Professional Med J 2024; 31(03):338-344. https://doi.org/10.29309/TPMJ/2024.31.03.7719

ABSTRACT… Objective: To study the optimal timing of Coronary artery bypass grafting (CABG) after acute myocardial infarction (MI). **Study Design:** Retrospective Cross-sectional study. **Setting:** Punjab Institute of Cardiology, Lahore. **Period:** January 2019 to January 2023. **Methods:** Patients who underwent on pump CABG grafting after MI were included in the study and divided into those who had surgery within 7 days (early surgery group) and those who had surgery after 7 days (late surgery group). Those with additional cardiac procedures, operated in emergency and those who underwent redo procedures were excluded from the study. Patients were followed for 30 days. Data was collected on pre-formed proformas and analyzed using IBM SPSS software (version 23, SPSS Inc., Chicago, IL, USA). **Results:** A total of 475 patients ((early surgery group, 224), (late surgery group, 251) were included in the study. Mean age was 52.75 ± 7.7 years. NSTEMI was significantly more in patients with early surgery (161) (71.9%) compared to 99 (39.3%) in the late group (p= 0.01). Intraoperatively, cross clamp time and bypass time was similar in both the groups (p=0.81 and 0.15 respectively). Mortality was (1.3%) in the early surgery group and 3 (1.2%) in the late operation group. **Conclusion:** Patients who suffered from myocardial infarction can undergo surgery after the acute phase with acceptable mortality and morbidity compared to those operated late.

Key words: Coronary Artery Bypass Grafting, Early Surgery, Late Surgery, Myocardial Infarction, Mortality.

INTRODUCTION

Coronary artery bypass grafting is recommended treatment strategy for patients with multivessel coronary artery disease, especially those who have diabetes, after myocardial infarction (MI). Although the treatment for ST elevation MI (STEMI) is primary PCI, with focus on decreasing door to balloon time, patients who had restoration of blood flow in the culprit vessel with multivessel disease elsewhere in the coronaries may still be referred for CABG.[1] The timing of CABG after an MI has been a debatable topic in literature. Studies have shown reduced risk of arrhythmias, recurrent ischemia, mechanical complications and cardiogenic shock if operated within 24 to 48 hours after STEMI.[2] This benefit may sometime come at a cost of increased bleeding incidence and stroke. Delaying CABG for more than 3 days may allow for recovery of myocardium from the acute insult of MI and thus better outcomes.

The decision of when to operate may generally depend upon factors like hemodynamic stability, comorbidities, the presence of coronary lesions at critical locations and symptoms of the patient. A meta-analysis by Lang et al. found that early CABG within 24 hours was associated with higher mortality and morbidity than late CABG after 24 hours in patients with ST-segment elevation myocardial infarction (STEMI), but not in patients with non-ST-segment elevation myocardial infarction (NSTEMI).[3] They suggested that CABG should be delayed until 24 hours later in STEMI patients, but not in NSTEMI patients. This implies that CABG can be performed with acceptable risks early in patients with NSTEMI. On the other hand, many cardiac centers may have a long waiting list of patients for CABG. Whether delaying surgery

1. MBBS, FCPS (Cardiac Surgery), FEBCTS (Adult Cardiac Surgery), MEBCTS, MRCPS (Glasgow), CHQP, Consultant Cardiac Surgery, Department of Cardiothoracic Surgery, Al Mana Hospital, Al Khobar, Saudi Arabia.2. MS (Cardiac Surgery), Consultant Cardiac Surgeon, Punjab Institute of Cardiology, Lahore.
2. MS (Cardiac Surgery), Consultant Cardiac Surgeon, Punjab Institute of Cardiology, Lahore.
3. MD, Consultant Cardiac Surgeon, John Hopkins, Bayview Medical Center, Baltimore, Maryland, United States.
4. French Board of Cardiovascular Surgery, Consultant Cardiac Surgeon, King Fahad Hospital, Ministry of Health, Albaha, Saudi Arabia
5. FRCS (c-Th), FRCS (Edinb), Consultant Cardiac Surgeon, Alamana Hospital, Khobar, Saudi Arabia.
6. Jordanian Board of Cardiac Surgery, Consultant Cardiac Surgeon, King Fahad Hospital, Ministry of Health, Albaha, Saudi Arabia.

Correspondence Address:
Dr. Muhammad Irfan
Punjab Institute of Cardiology, Lahore.
dr.irfanaslam@yahoo.com

Article received on: 31/07/2023
Accepted for publication: 29/01/2024

in such a scenario has implications related to outcomes is also important.

The purpose of this study is to evaluate the optimal timing of CABG after MI in a large cohort of patients with different types of MI. We hypothesize that early CABG within 7 days and those operated after 7 days have the same outcomes in stable patients.

METHODS

A retrospective cross-sectional study using prospectively collected data was conducted at a tertiary care hospital from January 2019 to January 2023. (Ethical review committee approval No. RTPGME-193 Dated: 23 August, 2023). Patients who had undergone first time coronary artery bypass grafting using cardiopulmonary bypass after experiencing myocardial infarction (MI) (ST elevation MI or Non-ST elevation MI)) were included in the study. Patients operated as salvage, those operated in emergency, redo procedures and those who had another cardiac procedure along with CABG were excluded from the study. Those who had CABG without the use of CPB and those who had presentation other than ST elevation myocardial infarction (STEMI) and Non-STEMI were also excluded.

Patients were divided into two groups based on timing since MI. Those who suffered from MI within the previous 7 days and those who had MI more than 7 days before the surgery.

A hospital computer-based database with complete record of all the patients operated in the unit was used for the study. Data was extracted on pre-formed questionnaire accounting for important perioperative variables. Patients who were operated within 7 days of MI were kept in one group because large scale registry data has shown similar outcomes for these patients compared to those operated after 7 days.[4]

Coronary artery bypass grafting was performed for all the patients through median sternotomy using cardiopulmonary bypass. A strategy of arrested heart with intermittent antegrade cold blood cardioplegia was used in CPB during grafting. Where applicable, left internal mammary artery for left anterior descending coronary artery and reverse great saphenous vein grafts were used for all the patients.

Preoperatively, patients were started on β-blockers if they were not taking it already. Patients with poor ejection fraction who had akinetic areas in the myocardium had assessment of viability through cardiac MRI.

Although patients were operated by different consultants, the perioperative protocols were identical for all the patients.

DATA ANALYSIS

The two groups were compared with respect to baseline characteristics as well as various perioperative variables using in IBM SPSS software (version 23, SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean and median with standard deviation for variance and comparative analysis of these variables was done through student t test between the two groups. Dichotomous variables were presented as frequencies and percentages and analyzed using Chi square test for significance.

RESULTS

Total number of patients included in the study was 476. Various perioperative characteristics of the cohort are presented in Table-I. The final analysis included 224 patients in the early CABG group and 251 patients in the late group. Mean of the patients in the early group was 52.27 ± 7.49 years in the early group and 53.18 ± 7.97 years in the late group.

Diabetes was present in 145 (64.7%) patients in the early surgery group compared to 167 (66.3%) in the late group. NSTEMI was significantly more in patients with early surgery (161) (71.9%) compared to 99 (39.3%) in the late group (p= 0.01). Similarly, more patients in the early group had STEMI. (57 (25.4%) vs 40 (15.9%), p=0.01). Other baseline characteristics in both the groups are compared in Table-II.

Variables		(n=476)
Age (years)		52.75 ± 7.7
BMI (Kg/m²)		26.97 ± 4.1
Diabetes mellitus		312 (65%)
Hypertension		313 (65.8%)
History of smoking or current smoker		100 (21%)
Dyslipidemia		295 (62%)
COPD		24 (5%)
Prior CVA		5 (1.1%)
NSTEMI		260 (54.6%)
STEMI		97 (20.4%)
Use of preoperative ACE inhibitors		83 (17.4%)
Use of preoperative β-blockers		381 (80%)
Clopidogrel taken within the last 5 days		99 (20.8%)
Preoperative HB (gm/dl)		14.11 ± 5.5
Preoperative platelet count		258.31 ± 80.7
Preoperative HBA_1c		7.43 ± 3.08
Ejection fraction (%)		49.44 ± 9.8
No. of coronary vessels involved	Single vessel disease	6 (1.3%)
	2 vessel disease	18 (3.8%)
	3 vessel disease	446 (93.7%)
Left main stem involved		129 (27.1%)
Previous PCI		36 (7.5%)
CPB time in minutes		122.88 ± 38.7
Cross clamp time in minutes		76.05 ± 22.5
Drain output in first 24 hours (ml)		394.41 ± 341.8
Use of IABP perioperatively		7 (1.5%)
Postoperative superficial wound infection		7 (1.5%)
Postoperative deep sternal wound infection		6 (1.3%)
Postoperative leg wound infection		6 (1.3%)
New onset postoperative atrial fibrillation		22 (4.6%)
Re-exploration for bleeding		22 (4.4%)
Stroke		5 (1.1%)
Mortality		6 (1.1%)

Table-I. Perioperative characteristics of all the patients included in the study. (n=476)

More patients in the early group were operated urgently (60) while electively operated patients were more in the late surgery group (218).

More patients in the early group had taken Plavix within the last 5 days of surgery compared to the late surgery group (73 (32.6%) vs 26 (10.3%), p=0.01). intraoperatively, cross clamp time and bypass time was similar in both the groups (p=0.81 and 0.15 respectively). Although more patients took Plavix in the previous 5 days in the early surgery group, the drain out put in the first 12 hours after surgery was similar in both the groups (p=0.19). Similarly, this did not convert to more exploration in this group (8 (3.6% vs 13 (5.2%) in the early surgery vs late surgery groups respectively, p=0.23). Postoperative atrial fibrillation was recorded in 10 (4.5%) patients in early surgery group compared to 12 (4.8%) in the late surgery group. Three patients (1.3%) were lost in the early surgery group while mortality in the late operation group was also 3 (1.2%). (Table-III).

DISCUSSION

This study compares the two time durations of CABG after MI in a sizeable cohort of patients. early surgery has been defined as that within 24 to 48 hours within MI but this is largely in the contest of STEMI and most of these patients are operated emergently. For this reason, they have different characteristics like hemodynamic status, ongoing arrhythmias, mechanical complications of MI and the use of short term mechanical circulatory support. For this reason, we excluded this group from our study and only included those patients who were operated urgently or electively, in a comparatively controlled circumstance. Nichols et al showed that patients who were operated within 7 days of MI had different outcomes than those operated after 7 to 21 days. Hence, we defined early surgery as within 7 days and late surgery as after 7 days in our study.[4]

Our study showed that once emergent patients are excluded, the timing of surgery does not influence mortality. This is in contrast to some studies published in the literature that has showed higher mortality for patients operated early. Thilak and colleagues showed significantly higher mortality for patients who were operated between 7 days (2.9%) and 30 days (5.9%) after MI.[5]

Variable		Early CABG (n=224)	Late CABG (n=252)	P-Value
Age (years)		52.27 ± 7.49	53.18 ± 7.97	0.20
BMI (Kg/m²)		27.04 ± 4.08	26.90 ± 4.27	0.71
Preoperative fibrinogen (mg/dl)		4.76 ± 1.40	4.42 ± 1.03	0.16
Preoperative heamoglobin (gm/dl)		14.11 ± 1.75	15.99 ± 21.6	0.19
Preoperative platelet count		259.07 ± 83.55	257.64 ± 78.28	0.84
Preoperative HbA_1c		7.33 ± 1.90	7.52 ± 3.86	0.52
Ejection fraction (%)		49.41 ± 8.97	49.46 ± 10.62	0.95
Diabetes mellitus		145 (64.7%)	167 (66.3%)	0.72
Hypertension		147 (65.6%)	166 (65.9%)	0.95
History of smoking		49 (21.9%)	51 (20.2%)	0.66
Dyslipidemia		136 (60.7%)	159 (63.1%)	0.59
COPD		12 (5.4%)	12 (4.8%)	0.76
NSTEMI		161 (71.9%)	99 (39.3%)	0.01
STEMI		57 (25.4%)	40 (15.9%)	0.01
NYHA class	I	59 (26.3%)	69 (27.4%)	0.32
	II	133 (59.4%)	131 (52.0%)	0.15
	III	7 (3.1%)	16 (63%)	
	IV	2 (0.9%)	3 (1.2%)	
Use of preoperative ACE inhibitors		37 (16.5%)	46 (18.3%)	0.61
CCS class	I	25 (11.2%)	32 (12.7%)	0.23
	II	140 (62.5%)	132 (52.4%)	
	III	38 (17%)	56 (22.2%)	
	IV	5 (2.2%)	8 (3.2%)	
Use of preoperative β-blockers		184 (82.1%)	196 (77.8%)	0.34
Left main >50% disease		71 (31.7%)	58 (23.0%)	0.03
Status of surgery	Urgent	60 (26.8%)	29 (11.5%)	0.01
	Elective	161 (71.9%)	218 (86.5%)	
Previous PCI		12 (5.36%)	24 (9.52%)	0.32

Table-II. Demographic and baseline characteristics of the patients.

Variable	Early CABG (n=224)	Late CABG (n=251)	P-Value
Cross clamp time (minutes)	76.32 ± 20.7	75.81 ± 24.10	0.81
Postoperative superficial chest wound infection	2 (0.9%)	5 (2.0%)	0.21
Postoperative saphencetomy wound infection	3 (1.3%)	3 (1.2%)	0.31
Deep sternal wound infection	1 (0.4%)	5 (2.0%)	0.10
Postoperative atriaf fibrillation	10 (4.5%)	12 (4.8%)	0.32
Postoperative stroke	4 (1.8%)	1 (0.4%)	0.10
Use of perioperative IABP	5 (2.2%)	2 (0.8%)	0.13
CPB time (minutes)	125.69 ± 42.33	120.38 ± 35.22	0.15
Chest drain output in first 24 hours (ml)	369.64 ± 279.01	418.73 ± 392.63	0.19
Re-exploration for bleeding	8 (3.6%)	13 (5.2%)	0.23
Mortality	3 (1.3%)	3 (1.2%)	0.74

Table-III. Important operative and postoperative variables.

They also demonstrated higher use of blood products, stroke and renal injury in these patients. on the other hand, Thielmann and colleagues described a hospital mortality of 2.4% when patients were operated 8 to 14 days after MI.[6] These contrasting outcomes may be attributed to the specific cohort of patients that was included in the studies. For instance, Thilak and colleagues included patients in the later surgery group that had more comorbidities. It is possible that surgery was delayed in these patients to give to for medical stabilization of these patients to render them relatively fit for surgery.

Our study included both STEMI and Non-STEMI patients and did not differentiate between them because it is usually the early surgery within a few hours of STEMI patients that carry poor outcomes.[7] Once this phase is over, their perioperative outcomes are generally similar. This phenomenon was discussed by Lee and colleagues in their study where they included patients with transmural and non-transmural MI and their outcomes after CABG.[8] In their study, the overall mortality for both STEMI and Non-STEMI patients was 3.1% but when both groups were analyzed separately with respect to time since MI, mortality was clearly high in the transmural group when operated early. We addressed this issue by excluding patients who were operated within a few hours after MI.

The overall cohort included in our study showed comparable outcomes with international literature with respect to major postoperative complications like re-exploration, stroke and wound complications.[9,10] However, the incidence of new onset postoperative atrial fibrillation of (4.5%) was much less in our cohort. This can be attributed to the relatively younger median age of our patients. Siddeqeh and colleagues also reported relatively lower rates of postoperative atrial fibrillation after CABG in Asian population.[11] This point to the more aggressive nature of coronary artery disease in Asian population and hence early presentation at a younger age.[12]

This study has certain implications for clinical practice. Our findings suggest that CABG performed after MI for both STEMI and Non-STEMI within 7 days has the same outcomes as surgical intervention after 7 days of MI. Secondly, when discussing the timing of surgery after MI, it is more plausible to exclude patients with STEM who were operated within hours of the insult as the short and long term outcome of these patients is different from those who are operated after a few days.[13] Moreover, patients operated within or after 7 days of MI have the same mortality and hence surgery should not be delayed for such patients if other comorbidities allow.

This is a retrospective study and has certain limitations. The decision for surgery involves various aspects of organ function and fitness and thus a retrospective non-randomized study is bound to ignore many confounding factors. Secondly, our study did not differentiate between patients presenting inferior STEMI and those presenting with anterior STEMI as this may have important implications as for as outcomes are concerned. Our study only presents the in-hospital outcomes and does not provide longer term follow up data thus we cannot infer the longterm outcomes of these two groups. Furthermore, our study includes only those patients who were operated on pump. It would be interesting to see the results of patients undergoing CABG after MI operated without the use of cardiopulmonary bypass as it avoids ischemic arrest of the heart. Nonetheless, our study provides real world data about CABG in patients with MI in a sizeable cohort and sheds light on important perioperative variables.

CONCLUSION

It can be concluded that CABG can be performed with acceptable mortality and complication rate for patients with MI within 7 days as well as after 7 days of MI. large scale studies like randomized control trials with well balanced cohorts may address the question definitively.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Copyright© 29 Jan, 2024.

REFERENCES

1. Malmberg M, Sipilä J, Rautava P, Gunn J, Kytö V. **Outcomes After ST-Segment Versus Non-ST-Segment elevation myocardial infarction revascularized by coronary artery bypass grafting.** Am J Cardiol. 2020 Nov 15; 135:17-23. doi: 10.1016/j.amjcard.2020.08.042. Epub 2020 Aug 29. PMID: 32871111.

2. Tomura N, Honda S, Takegami M, Nishihira K, Kojima S, Takayama M, Yasuda S; JAMIR investigators. **Characteristics and In-Hospital outcomes of patients who underwent coronary artery bypass grafting during hospitalization for ST-Segment Elevation or Non-ST-Segment elevation myocardial infarction.** Ann Thorac Cardiovasc Surg. 2023 Jul 7. doi: 10.5761/atcs.oa.23-00016. Epub ahead of print. PMID: 37423750.

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 Mar 28; 9:794925. doi: 10.3389/fcvm.2022.794925. PMID: 35419440; PMCID: PMC8995744.

4. Nichols EL, McCullough JN, Ross CS, Kramer RS, Westbrook BM, Klemperer JD, Leavitt BJ, Brown JR, Olmstead E, Hernandez F, Sardella GL, Frumiento C, Malenka D, DiScipio A; **Northern new england cardiovascular disease study group. optimal timing from myocardial infarction to coronary artery bypass grafting on Hospital Mortality.** Ann Thorac Surg. 2017 Jan; 103(1):162-171. doi: 10.1016/j.athoracsur.2016.05.116. Epub 2016 Aug 25. PMID: 27570160.

5. Thilak AP, Thacker D, Shales S, Das D, Behera SK, Ghosh AK, Narayan P. **Timing of coronary artery bypass grafting after acute myocardial infarction: Does it influence outcomes?** Kardiochir Torakochirurgia Pol. 2021 Mar; 18(1):27-32. doi: 10.5114/kitp.2021.105184. Epub 2021 May 15. PMID: 34552641; PMCID: PMC8442093.

6. Thielmann M, Neuhäuser M, Marr A, Herold U, Kamler M, Massoudy P, Jakob H. **Predictors and outcomes of coronary artery bypass grafting in ST elevation myocardial infarction.** AnnThorac Surg. 2007; 84:17-24.

7. De Carlo M, Maselli D, Cortese B, Ciabatti N, Gistri R, Levantino M, Balbarini A, De Caterina R, Petronio AS. **Emergency coronary artery bypass grafting in patients with acute myocardial infarction treated with glycoprotein IIb/IIIa receptor inhibitors.** Int J Cardiol. 2008 Jan 24; 123(3):229-33. doi: 10.1016/j.ijcard.2007.02.005. Epub 2007 Apr 11. PMID: 17433463.

8. Lee DC, Oz MC, Weinberg AD, Lin SX, Ting W. **Optimal timing of revascularization: transmural versus nontransmural acute myocardial infarction.** Ann Thorac Surg. 2001 Apr; 71(4):1197-202; discussion 1202-4. doi: 10.1016/s0003-4975(01)02425-0. PMID: 11308159.

9. Gaudino MFL, Spadaccio C, Taggart DP. **State-of-the-Art coronary artery bypass grafting: Patient selection, graft selection, and optimizing outcomes.** Interv Cardiol Clin. 2019 Apr; 8(2):173-198. doi: 10.1016/j.iccl.2018.11.007. Epub 2019 Jan 28. PMID: 30832941.

10. Sandner S, Misfeld M, Caliskan E, Böning A, Aramendi J, Salzberg SP, Choi YH, Perrault LP, Tekin I, Cuerpo GP, Lopez-Menendez J, Weltert LP, Böhm J, Krane M, González-Santos JM, Tellez JC, Holubec T, Ferrari E, Doros G, Vitarello CJ, Emmert MY; **Registry Investigators; European DuraGraft Registry investigators'. Clinical outcomes and quality of life after contemporary isolated coronary bypass grafting: A prospective cohort study.** Int J Surg. 2023 Apr 1; 109(4):707-715. doi: 10.1097/JS9.0000000000000259. PMID: 36912566.

11. Siddiqeh, M., Khan, I., Fayaz, F.- e-, Hasan Kirmani, S. M., Hamshary, M. E., ., W., Khan, Z. M., & Javaid, R. (2022). **Incidence and predictors of postoperative atrial fibrillation after coronary artery bypass grafting surgery.** Pakistan Armed Forces Medical Journal. 72(SUPPL-3); S599-603. https://doi.org/10.51253/pafmj.v72iSUPPL-3.9563.

12. Gijsberts CM, den Ruijter HM, Asselbergs FW, Chan MY, de Kleijn DP, Hoefer IE. **Biomarkers of coronary artery disease differ between Asians and Caucasians in the general population.** Glob Heart. 2015 Dec; 10(4):301-311.e11. doi: 10.1016/j.gheart.2014.11.004. Epub 2015 Mar 7. PMID: 26014657.

13. Merdler I, Gabarin M, Loewenstein I, Letourneau S, Zahler D, Hochstadt A, Szekely Y, Banai S, Shacham Y. **Long-term outcomes in st elevation myocardial infarction patients undergoing coronary artery bypass graft versus primary percutaneous coronary intervention.** Isr Med Assoc J. 2020 Jun; 22(6):352-356. PMID: 32558440.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Imran Khan	Study conception, Design, Manuscript writing, Statiscal analysis.	
2	Muhammad Irfan	Manuscript writing.	
3	Fazila Khan	Manuscript editing.	
4	Abdelbasset El Refy	Manuscript editing, Study design.	
5	Zahid Khan	Statistical analysis.	
6	Yaqzan Obeidat	Manuscript writing.	