Original Article

A Comparison of Outcomes of Minimal Invasive CABG vs Routine Sternotomy CABG

Vijay Shewale[1], Jayant Khandekar[2]

[1]Assistant Professor, Department of C.V.T.S, LokmanyaTilak Municipal Medical College and General Hospital, Mumbai, Maharashtra, India.

[2]Professor and Head, Department of C.V.T.S, LokmanyaTilak Municipal Medical College and General Hospital, Mumbai, Maharashtra, India.

Abstract

Background: Coronary artery bypass graft (CABG) surgery via sternotomy remains the standard of care for patients with multivessel coronary artery disease (CAD). Minimally invasive cardiac surgery (MICS)-CABG via left anterior thoracotomy has been used as an alternative to sternotomy. Although MICS CABG is not new technique, its employed by very few surgeons. The aim of our study was to assess the early and late post operative outcomes in both groups. **Material and Methods:** Patients who underwent either MICS CABG or routine sternotomy CABG between August 2022 and July 2023 were reviewed. We excluded the patients with an ejection fraction of less than 30%, those who had had previous cardiac surgery and concomitant valve replacement.**Results:** 92 patients of MICS and 98 patients of routine sternotomy were selected for study and follow up was done for one year. Demographic characteristics in both groups were similar. Difference between duration of surgery was statistically significant. In early and late post-operative outcome , duration of mechanical ventilation and total hospital stay was significantly less in MICS group. Myocardial infarction, heart failure, reintervention and death were similar in both groups.**Conclusion:** MICS CABG can be performed safely in appropriately selected patients with outcomes comparable with routine sternotomy CABG. The potential benefits include shorter hospital stay and fast recovery.

Keywords: Minimal invasive CABG, routine CABG, MICS, sternotomy.

Received: 01 June 2026 **Revised: 20 June 2026** **Accepted: 02 July 2026** **Published: 11 July 2026**

Introduction

The 5-year results of the Synergy Between Percutaneous Coronary Intervention With Taxsus and Cardiac Surgery (SYNTAX) study and the findings of the Future Revascularization Evaluation in Patients With Diabetes Mellitus: Optimal Management of Multivessel Disease (FREEDOM) trial have recently confirmed that coronary artery bypass grafting (CABG) is the safest and most effective way to achieve myocardial revascularization in patients with triple-vessel coronary artery disease (CAD) and in diabetic patients with multivessel CAD.[1-3]

For many years, CABG via midline sternotomy has been the gold standard for coronary revascularization in multivessel coronary artery disease. Recently new approaches, including the minimally invasive cardiac surgery CABG (MICS-CABG) via a small left anterior thoracotomy, have emerged as safe and effective alternative.[4-7] MICS-CABG is performed via left thoracotomy using a 6- to 7-cm incision with a significant reduction in chest trauma, better cosmesis, less postoperative pain, early recovery and short hospital stay.[8,9]

However, MICS can be technically challenging. Concerns have been raised regarding slightly higher ratesof adverse cardiac events than for conventional off-pumpsurgery.[6] Many feel that the quality of the MIDCAB procedurecan be maintained only when performed in a centrewith a high caseload in order to allow surgeons to preservea high level of skills.[10,11] However, the durability of this approach and its impact on short term andlong-term survival have yet to be confirmed. The aim of this study to compare the effects of minimal invasive CABG vs sternotomy CABG on short term and long-term survival.

Materials and Methods

92 patients who underwent MICS CABG between August 2022and July 2023 were compared with the 98 patients whounderwent off-pump CABG surgerythrough a median sternotomy during the same timeperiod. We excluded the patients with an ejection fraction of less than 30%, those who had had previous cardiac surgery and concomitant valve replacement.

Data collection: This was an observational retrospective cohort study, data collected from medical records and during OPD follow up. Outcome measurescomprised early (within 30 days postoperatively) and lateevents. Late complications (within one year) included late death, recurrent angina or myocardial

Address for correspondence: Dr. Vijay Shewale, Assistant Professor, Department of C.V.T.S, LokmanyaTilak Municipal Medical College and General Hospital, Mumbai, Maharashtra, India.
E-mail: drvijayshewale@gmail.com

DOI:
10.21276/amit.2026.v13.i2.820

How to cite this article: Shewale V, KhandekarJ.A Comparison of Outcomes of Minimal Invasive CABG vs Routine Sternotomy CABG. Acta Med Int. 2026;13(2):1046-1049.

infarction, reintervention(coronary artery bypass surgery or percutaneouscoronary intervention) and cerebrovascular accident.

Surgical technique: MICS-CABG is performed via left anterior thoracotomy with 6 to 8cm incision in the left fourth or fifth intercostal space, according to apex beat palpation. The left internalmammary artery (LIMA) is skeletonized under direct vision usinglong instruments. The pericardium is opened. Meanwhile, radial artery and / or saphenous venous grafts areharvested. Proximal anastomosis is facilitated by bringing theascending aorta closer to the thoracotomy wound using the followingtechniques: putting extra gauze piece away from incision site and depressing pulmonary trunk by an epicardial stabilizer. For distal anastomoses, routine apical positioner was used. Retraction of the cardiac apex towards thepatient's left shoulder and the right hip allows visualization of theposterior descending artery and the circumflex coronary arterymarginal branches, respectively. Coronaryanastomosis is performed by using running 7-0 polypropylene. Atthe end of the procedure, all grafts are inspected under directvision to rule out kinking or tension.

Statistical analysis: Standardized difference scores were estimated to compare baseline covariates between MICS and Sternotmycabg. A 1:1 propensity score matching (PSM) of MICS andsternotmy minimized this potential selection bias. The propensity scores were estimated with a multivariable logistic regression model. Standardize differences for all baseline covariates were less than 10 in the matched sample, which suggests a balance of covariates between the MICS and sternotomy CABG groups. Separate logistic regression models were used to estimate the associations (odds ratio [OR]) between both groups. Each of the models fitted to the unmatched data was adjusted with the logit of the propensity scores (quintiles) to control for preoperation confounders. The greedy matching algorithm was implemented for matching. This macro comes with prespecified parameters and has been extensively applied for matching cases and controls. We performed covariate adjustment by using the quintiles of propensity scores to estimate adjusted ORs for the association between both groups and postsurgical outcomes. We reported unadjusted ORs from models fitted to the PSM sample because further propensity score adjustment did not alter the ORs. For prespecified subgroup analysis, similar statistical methods were applied to evaluate the comparison between two groups and surgical outcomes in patient samples stratified by type of cardiac procedure. All reported p values were 2-sided, and p values less than 0.05 were considered statistically significant. All statistical analyses were completed with SAS, version 9.3 statistical software.

RESULTS

Between August 2022 and July 2023, a total of 400 patients underwent CABG (MICS and routine sternotomy). Exclusion criteria wereapplied, patients with ejection fraction less than 30%, concomitant valve replacement surgery and patients with history of previous cardiac surgery were excluded. 92 patients of MICS and 98 patients of routine sternotomy were selected for study and follow up was done for one year.

[Table1] Demographic characteristics in both groups were comparable P value more than 0.05 except three variables i.e Ejection fraction (EF more in MICS group), COPD (few patients had COPD in MICS group), peripheral vascular disease (PVD less in MICS group).

[Table2] Number of distal anastomosis, use of cardiopulmonary bypass, requirement of blood transfusion, incomplete revascularisation use of intraaorticballon pump (IABP) were comparable in both groups. Difference between duration of surgery was statistically significant (p value less than 0.05),mean duration was 240 minutes in MICS group and 300.70 minutes in standard sternotomy surgery. Regarding conduits used in patients, LIMA was used in all cases, use of saphenous vein and radial artery equal in both groups and RIMA use in standard sternotomy was significantly high.

[Table3] In early post-operativeoutcome, mechanical ventilation duration and total duration of stay in hospital was significantly low in MICS group. Other variables like atrial fibrillation, reexploration for bleeding, stroke, death, wound infection (superficial) were equal in both groups.

[Table4] In late post operative outcome (one year follow up) comparison did not show any statistically significant difference between variables like recurrent angina, myocardial infarction, heart failure , stroke, death, superficial wound infection , angioplasty and redo CABG.

Table 1: Patient demographics (Baseline characteristics in both group)

Variables	MICS(n=92)	Strernotomy(n=98)	P value
Age	67.57+/-9.3	66.37+/-8.5	0.918
Sex (male)	64(69.5%)	65(66.32%)	0.204
BMI (kg/m2)	28.23+/-4.53	28.30+/-5.01	0.926
Family history	18(19.56%)	19(19.38%)	0.836
Smoking	39(42.39%)	40(40.81%)	0.924
Diabetes	39(42.39%)	25(25.51%)	0.142
Hypertension	64(69.56%)	66(67.34%)	0.825
Myocardial infarction	51(55.43%)	45(45.91%)	0.57
History of heart failure	17(18.47%)	10(10.20%)	0.190
Previous angioplasty	18(19.56%)	19(19.38%)	0.756
Acute renal failure	10(10.86%)	12(12.24%)	0.867
Stroke	17((18.47%)	12(12.24%)	0.85
COPD	2(2.17%)	12(12.24%)	0.03
Ejection fraction	51.25	38.43	0.04
SYNTAX score	27.13+/-9.60	24.79+/-9.99	0.67

NYHA class ¾	38(41.30%)	22(22.44%)	0.206
Peripheral vascular disease	2(2.17%)	12(12.24%)	0.045

Table 2: Intra-operative variables in both group

Variables	MICS(n=92)	Sternotomy(n=98)	P value
Number of distal anastomosis	3.7	3.9	0.856
Use of CPB	3(3.26%)	4(4.08%)	0.934
Incomplete revascularisation	2(2.17%)	3(3.06%)	0.745
Blood transfusion	2(2.17%)	2(2.04%)	0.834
Duration of surgery(minutes)	240	300.70	0.04
Use of IABP	7(7.60%)	7(7.14%)	0.34
Saphenous vein	40(43.47%)	50(51.02%)	0.43
Radial artery	65(70.65%)	67(68.36%)	0.56
RIMA	30(32.60%)	5(5.10%)	0.034

Table 3: Early post operative outcomes in MICS and Sternotomy patients

Variables	MICS(n=92)	Sternotomy(n=98)	P value
Length of stay (days)	4.2 +/-0.6	6.4 +/-1.2	0.045
Ventilation duration (hours)	8.4 +/-2.3	26.34 +/- 4.5	0.03
Atrial fibrillation	1(1.08%)	1(1.02%)	0.856
Reoperation for bleeding	2(2.17%)	2(2.04%)	0.79
Stroke	1(1.08%)	1(1.02%)	0.67
Death	1(1.08%)	1(1.02%)	0.67
Wound infection	1(1.08%)	3(3.06%)	0.23

Table 4: Late post operative outcomes in MICS and sternotomy patients

Variables	MICS(n=92)	Sternotomy(n=98)	P value
Recurrent angina	2(2.17%)	2(2.04%)	0.796
Heart failure	1(1.08%)	1(1.02%)	0.785
Myocardial infarction	1(1.08%)	1(1.02%)	0.561
Stroke	1(1.08%)	1(1.02%)	0.612
Death	1(1.08%)	1(1.02%)	0.833
Wound infection	1(1.08%)	1(1.02%)	0.712
Angioplasty	1(1.08%)	1(1.02%)	0.665
Redo CABG	0	0	-

Discussion

The main finding of this report is that multivessel coronary revascularization can be performed minimally invasively in a large number of patients, with wide applicability and excellent procedural outcomes. The 4 important parameters to evaluate the efficacy of CABG surgery are myocardial infarction, heart failure, need for reintervention(angioplasty or redo CABG) and death were similar in both groups. The advantage of MICS was seen in early discharge from hospital and less duration of mechanical ventilation. Other early and late outcomes were similar in both groups

The first minimally invasive bypass grafting of the LAD with the LITA was reported by VasiliiKolesov and performed via a left anterior thoracotomy. The MIDCAB procedure followed the popularisation of off pump bypass surgery and placed emphasis on its minimal access approach. The technique combines a favourable event free survival after surgical revascularisation of the LAD with the potentially quicker recovery.[12-14]

A study of MICS CABG patients has also shown an outcome comparable with routine CABG in terms of operative time, postoperative morbidity, postoperative course and in-hospital mortality.[15] The authors also demonstrated superior results in less duration of mechanical ventilation and less postoperative hospital stay in the MICS group, which is consistent with the minimally invasive approach in our series.

A study of 1,400 minimally invasive cardiac surgery procedures at the Cleveland Clinic demonstrated an overall wound infection rate of 2.9% and a deep infection rate of 1.9% but failed to show any significant difference when compared with traditional open heartsurgery.[16] Wound infection rate was similar in both groups in our study and none of the patients required debridement or vacuum dressing.

Another retrospective review of 165 consecutive MICS cases demonstrated wound complications in 15 patients (9.1%), including 2 incisional hernias (1.8%), 4 superficial (2.4%), 3 wound infections (1.8%), 3 chronic pain syndromes (1.8%) and 2 seromas (1.2%).[17] In our study, postoperative pain and quality of life were not evaluated. As these two parameters are perceived advantages of MICS (as compared with a sternotomy), a prospective study has been planned.

Conclusion

Over the years, a sizable number of these MICS CABG operations have been taught, adopted and performed worldwide. It is important for surgeons who want to perform or appraise this technique to be provided with validated, objective quantification of the efficacy and quality of this procedure. Whether MICS CABG in its current form is applicable to all centres, all surgeons, and all patients remains open to debate, but the key, novel finding of this study is that multivessel

coronary revascularization can be performed minimally invasively in a large number of patients with excellent early and late outcomes.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Mohr FW,Morice MC, Kappetein AP, Feldman TE, Stahle E, Colombo A, et al. Coronary artery bypass graft surgery versus percutaneous coronary intervention in patients with three-vessel disease and left main coronary disease: 5-year follow-up of the randomised, clinical SYNTAX trial. Lancet. 2013;381:629-38.
2. Farkouh ME, Domanski M, Sleeper LA, Siami FS, Dangas G, Mack M, et al. Strategies for multivessel revascularization in patients with diabetes. N Engl J Med. 2012;367:2375-84.
3. Farkouh ME, Domanski M, Fuster V. Revascularization strategies in patients with diabetes. N Engl J Med. 2013;368:1455-6.
4. McGinn JT Jr, Usman S, Lapierre H, Pothula VR, Mesana TG, Ruel M. Minimally invasive coronary artery bypass grafting: dual-centerexperience in 450 consecutive patients. Circulation 2009;120(Suppl 11):S78–84.
5. Hoff SJ, Ball SK, Leacche M, Solenkova N, Umakanthan R, Petracek MR et al. Results of completion arteriography after minimally invasive off-pump coronary artery bypass. Ann Thorac Surg2011;91:31–6.
6. Chan V, Lapierre H, Sohmer B, Mesana TG, Ruel M. Handsewn proximal anastomoses onto the ascending aorta through a small left thoracotomy during minimally invasive multivessel coronary artery bypass grafting: a stepwise approach to safety and reproducibility. SeminThoracCardiovasc Surg2012;24:79–83.
7. Ruel M, Shariff MA, Lapierre H, Goyal N, Dennie C, Sadel SM et al.Resultsof the minimally invasive coronary artery bypass grafting angiographic patency study. J ThoracCardiovasc Surg2014;147:203–8.
8. Poston RS, Tran R, Collins M, Reynolds M, Connerney I, Reicher B et al. Comparison of economic and patient outcomes with minimally invasive versus traditional off-pump coronary artery bypass grafting techniques. Ann Surg2008;248:638–46.
9. Lapierre H, Chan V, Sohmer B, Mesana TG, Ruel M. Minimally invasive coronary artery bypass grafting via a small thoracotomy versus off-pump: a case-matched study. Eur J CardiothoracSurg2011;40:804–10.
10. Vicol C, Nollert G, Mair H et al. Midterm results of beating heart surgery in1-vessel disease: minimally invasive direct coronary artery bypass versus offpumpcoronary artery bypass with full sternotomy. Heart Surg Forum 2003; 6:341–344.
11. Holzhey DM, Jacobs S, Mochalski M et al. Seven-year follow-up after minimallyinvasive direct coronary artery bypass: experience with more than 1300patients. Ann ThoracSurg 2007; 83: 108–114.
12. Stanbridge RD, Hadjinikolaou LK. Technical adjuncts in beating heart surgery comparisonof MIDCAB to off-pump sternotomy: a meta-analysis. Eur J CardiothoracSurg 1999; 16: S24S33.
13. Kolessov VI. Mammary artery–coronary artery anastomosis as method of treatment for angina pectoris. J ThoracCardiovascSurg 1967; 54: 535–544.
14. Ben-Gal Y, Mohr R, Braunstein R et al. Revascularization of left anterior descending artery with drug-eluting stents: comparison with minimally invasive direct coronary artery bypass surgery. Ann ThoracSurg 2006; 82: 2,067 2,071.
15. Fouad AS, Khallaf AN, Eltawil T et al. MIDCAB versus conventional CABG peri-operative results of single vessel anastomosis (LIMA–LAD) – retrospective comparative study of Egyptian 10-year-experience. Presented at: 21st World Congress of the World Society of Cardio-Thoracic Surgeons; June 2011; Berlin.
16. Gordon SM. New surgical techniques and surgical site infections. Emerg Infect Dis 2001; 7: 217–219.
17. Ng PC, Chua AN, Swanson MS et al. Anterior thoracotomy wound complications in minimally invasive direct coronary artery bypass. Ann ThoracSurg 2000; 69: 1,338–1,340.