

MIDCAB Versus Off-Pump CABG: A Comparative Study

MUHAMMAD ARSALAN ALI¹, MUHAMMAD AHMED², HAMAD ALI SHAH³

¹Resident Surgeon, Department of Surgery, KRL Hospital, Islamabad

²MBBS, Rawalpindi Medical University and Allied Hospitals, Rawalpindi

³Resident Surgeon, Department of Surgery, KRL Hospital, Islamabad

Correspondence to: Muhammad Arsalan Ali, Email: arsalanz777@gmail.com, Cell: 03335358536

ABSTRACT

Introduction: Treatment for coronary artery disease (CAD) includes medical therapy, percutaneous coronary intervention (PCI) and coronary artery bypass grafting.

Objectives: The main objective of the study is to find the comparison of MIDCAB vs open off-pump procedure CABG for single vessel coronary disease.

Material and methods: This comparative analysis was conducted at Rawalpindi Institute of Cardiology, Armed Forces Institute of Cardiology, Rawalpindi and Shifa International Hospital, Islamabad from October 2019 to 2021. Informed consent was taken from all the patients before collecting the data. Patients in the MIDCAB group received sub-station hybridization to treat the diseased vessels except the left anterior descending (LAD). Patients in the OPCAB group were placed in the supine position, and combined intravenous inhalational anaesthesia was given; then, single-lumen endotracheal intubation was performed through the median incision.

Results: The data were collected from 100 coronary artery disease patients. The mean age of the study patients was 54.4±10.6 years. Cigarette smoking was much more common in men than in women (32.6% vs. 0, $p < 0.001$). The serum levels of creatinine, uric acid, and cTAS were significantly higher in men than in women (0.9 ± 0.2 vs. 0.7 ± 0.1 , 7.6 ± 2.1 vs. 6.8 ± 2.3 , and 0.4 ± 0.0 vs. 0.3 ± 0.1 , respectively; $p < 0.001$).

Conclusion: It is concluded that MIDCAB procedures can be performed with similar safety as OPCAB procedures. Postoperative outcomes in terms of mortality were satisfactory, rendering this procedure at least as safe as the option of OPCAB.

Practical implications: MIDCAB is considered to be the safe procedure and we may practically use this method.

Key words: MIDCAB, OPCAB, Mortality, Coronary Artery Diseases, Procedures

INTRODUCTION

Treatment for coronary artery disease (CAD) includes medical therapy, percutaneous coronary intervention (PCI) and coronary artery bypass grafting. Depending on symptoms, prognosis and predicted surgical mortality, next to complex three-vessel and left main disease coronary artery bypass is recommended for vessel disease of the proximal left anterior descending artery (LAD)¹.

However, because of lower costs, quicker recovery and lesser invasiveness with supposed fewer complications, PCI with stenting is the most used treatment for isolated stenosis of the LAD. Since the first reports of the off-pump technique and minimally invasive access, coronary artery bypass grafting (CABG) performed through a small anterior lateral thoracotomy without cardiopulmonary bypass has become an increasingly popular technique worldwide². The minimally invasive direct coronary artery bypass (MIDCAB) has been used for patients with a single vessel disease when a coronary stent placement failed³.

A significant stenosis in the proximal left anterior descending (LAD) artery can jeopardise a large area of the myocardium⁴. A variety of therapeutic options, including full-sternotomy on- or off-pump coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI) and minimally invasive direct coronary artery bypass (MIDCAB) grafting, are available to tackle this potentially life-threatening lesion of the LAD. On-pump CABG has become the standard of care for surgical myocardial revascularization world-wide⁵. However, the morbidity associated with cardiopulmonary bypass (CPB) coupled with full-sternotomy approach make on-pump CABG a very invasive strategy for revascularization of isolated LAD⁶. This is an important consideration particularly for high-risk patients. On the other hand, although off-pump CABG through full sternotomy for isolated LAD disease abolishes or at least reduces CPB-associated morbidity yet the potential risk of infective complications associated with full sternotomy persists⁷. Coronary artery disease (CAD) is nowadays responsible for approximately 15% of hospitalizations in Poland. Despite improvement in epidemiology in the last two decades, the early mortality rate (below 65 years old) is still high for these patients, and CAD remains the leading cause of death in developed countries⁸.

According to the European Society of Cardiology (ESC) guidelines, revascularization in multivessel stable CAD with proximal left anterior descending (LAD) artery involvement is recommended as the best treatment option, and coronary artery bypass grafting (CABG) proves to be beneficial over percutaneous coronary intervention (PCI) in terms of recurrent angina and repeat revascularization⁹. The traditional approach for CABG involves a median sternotomy and supplying narrowed arteries with arterial or venous grafts, as it is described elsewhere. In the case of proximal LAD stenosis, the best treatment option includes using left internal mammary artery (LIMA), which has been proved to diminish early postoperative mortality and has excellent both short and long-term results in all age groups, including elder and diabetic patients¹⁰.

Objectives: The main objective of the study is to find the comparison of MIDCAB vs open off-pump procedure CABG for single vessel coronary disease.

MATERIAL AND METHODS

This comparative analysis at conducted in Rawalpindi Institute of Cardiology, Armed Forces Institute of Cardiology, Rawalpindi and Shifa International Hospital, Islamabad from October 2019 to 2021. Informed consent was taken from all the patients before collecting the data.

Inclusion criteria

- All patients who have undergone MIDCAB and off-pump coronary surgery.

Exclusion criteria

- Those who had had previous cardiac surgery
- Those who do not want to participate in the study.

Data collection

The data was collected with the permission of ethical committee of the hospital. The data were divided into two groups:

Group I: MIDCAB group

Group II: OPCAB group

Patients in the MIDCAB group received sub-station hybridization to treat the diseased vessels except the left anterior descending (LAD). Patients in the OPCAB group were placed in the supine position, and combined intravenous-inhalational anesthesia was given; then, single-lumen endotracheal intubation was performed through the median incision. Patients in the MIDCAB group were

placed in the supine position, and the bed was elevated at 30° on the left. Defibrillation electrodes were conventionally placed on the chest away from the incision. Combined intravenously inhalational anesthesia was given and double-lumen tracheal intubation was conducted after induction, followed by one-lung ventilation on the right side during the whole process.

Statistical analysis: The data was analyzed using SPSS version 20. All the values were expressed in mean and standard deviation.

RESULTS

The data was collected from 100 coronary artery disease patients. The mean age of the study patients was 54.4±10.6 years. Cigarette smoking was much more common in men than in women (32.6% vs. 0, p<0.001). The serum levels of creatinine, uric acid, and cTAS were significantly higher in men than in women (0.9±0.2 vs. 0.7±0.1, 7.6±2.1 vs. 6.8±2.3, and 0.4±0.0 vs. 0.3±0.1, respectively; p<0.001).

Table 01: Clinical and laboratory characteristics of Respondents before surgery

	All patients		
	MIDCAB	OPCAB	P-value
Age, years	49.20±10.70	56.95±9.53	<0.001
BMI, kg/m ²	27.36±4.55	28.04±4.25	0.237
Hypertension	27 (30.7)	78 (44.8)	0.027
Diabetes	4 (4.5)	36 (20.7)	0.001
Hyperlipidemia	39 (44.3)	117 (67.2)	<0.001
FH of CAD	8 (9.1)	25 (14.4)	0.223
FBS, mg/dL	102.93±36.77	119.23±43.39	0.002
Gensini score	0	28.5 (8 to 59)	<0.001
LVEF, %	54.30±5.90	50.79±9.28	0.002
cTAS, mmol/L	0.37±0.89	0.39±0.93	0.050

The mean hospital stay was significantly reduced in the MIDCAB population (p<0.05). The mean intensive care unit stay in the MIDCAB group was 41.88 ± 22.20 hours compared with 62.91 ± 79.01 hours for OPCAB patients.

Table 2. Comparisons of data between the two groups after surgery

Indicator	OPCAB group	MIDCAB group	p
Operation time (h)	4.91 ± 1.89	3.91 ± 2.25	0.02
Blood transfusion during operation (unit)	3.01 ± 4.38	1.00 ± 1.14	0.00
Postoperative pleural effusion volume (mL)	1089.14 ± 451.91	789.81 ± 329.18	0.08
Ventilator use time after operation (h)	22.01 ± 59.85	11.98 ± 9.68	0.02
ICU stay (h)	62.91 ± 79.01	41.88 ± 22.20	0.00
In-hospital stay	19.46 ± 9.92	11.29 ± 6.35	0.01
In-hospital mortality	2 (1.35)	1 (1.9)	0.19

DISCUSSION

The first minimally invasive bypass grafting of the LAD with the LITA was reported by Vasili Kolesov and performed via a left anterior thoracotomy. The MIDCAB procedure followed the popularisation of OPCAB 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 recovery¹¹. However, this approach is practised only by a few surgeons. This is possibly due to concerns raised by a few series reporting their early experiences in the era before the widespread usage of newer stabilisers¹².

Minimally invasive approaches have been of interest to many surgeons recently as general advantages include quick rehabilitation and superior cosmetic results. Low perioperative mortality comparable to conventional off-pump technique has been previously reported, which is consistent with the study findings¹³. Nevertheless, the most appealing benefits consist of lowering the incidence of expensive complications, such as deep wound infection and sternal dehiscence, which in the study were observed only in the OPCAB group¹⁴⁻¹⁶. Aside from newly instituted

hemodialysis, these complications have been determined to highly increase the surgery cost, up to \$56,003 in the American study and €36,261 in the European one¹⁷. In contrast, surgical site infections after minimally invasive surgery are usually superficial and occur mostly in obese and female patients when the pressure placed on the wound edges by the retractor leads to tissue necrosis¹⁸⁻²⁰.

CONCLUSION

It is concluded that MIDCAB procedures can be performed with similar safety as OPCAB procedures. Postoperative outcomes in terms of mortality were satisfactory, rendering this procedure at least as safe as the option of OPCAB.

REFERENCES

- Boonstra PW, Grandjean JG, Mariani MA. Improved method for direct coronary grafting without CPB via anterolateral small thoracotomy. *Ann Thorac Surg* 1997; 63: 567-569.
- Kolesov VI. Mammary artery-coronary artery anastomosis as method of treatment for angina pectoris. *J Thorac Cardiovasc Surg* 1967; 54: 535-544.
- Calafiore AM, Di Giammarco G, Teodori G et al.. Midterm results after minimally invasive coronary surgery (LAST operation). *J Thorac Cardiovasc Surg* 1998; 115: 763-771.
- Fouad AS, Khallaf AN, Eltawil T et al. MIDCAB versus conventional CABG perioperative 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.
- Diegeler A, Walther T, Metz S et al.. Comparison of MIDCAP versus conventional CABG surgery regarding pain and quality of life. *Heart Surg Forum* 1999; 2: 290-295.
- Gummert JF, Funkat A, Krian A. Cardiac surgery in Germany during 2004: a report on behalf of the German Society for Thoracic and Cardiovascular Surgery. *J Thorac Cardiovasc Surg.* 2005;53:391-9.
- LaPar DJ, Crosby IK, Rich JB, et al. A contemporary cost analysis of postoperative morbidity after coronary artery bypass grafting with and without concomitant aortic valve replacement to improve patient quality and cost-effective care. *Ann Thorac Surg.* 2013;96:1621-7.
- Ruel M, Shariff MA, Lapierre H. Results of the minimally invasive coronary artery bypass grafting angiographic patency study. *J Thorac Cardiovasc Surg.* 2014;147:203-8.
- Piatek J, Kedziora A, Konstany-Kalandyk J, Kielbasa G, Olszewska M, Wróbel K, Song BH, Darocha T, Wrózek M, Kapelak B. Minimally invasive coronary artery bypass as a safe method of surgical revascularization. The step towards hybrid procedures. *Postępy Kardiol Interwencyjnej.* 2017;13(4):320-325. doi: 10.5114/aic.2017.71614. Epub 2017 Nov 29. PMID: 29362575; PMCID: PMC5770863.
- Shirai K, Lansky AJ, Mehran R, et al. Minimally invasive coronary artery bypass grafting versus stenting for patients with proximal left anterior descending coronary artery disease. *Am J Cardiol* 2004;93:959-62
- Antje-Christin Deppe, Oliver J. Liakopoulos, Elmar W. Kuhn, Ingo Slottoch, Maximilian Scherner, Yeong-Hoon Choi, Parwis B. Rahmianian, Thorsten Wahlers, Minimally invasive direct coronary bypass grafting versus percutaneous coronary intervention for single-vessel disease: a meta-analysis of 2885 patients, *European Journal of Cardio-Thoracic Surgery*, Volume 47, Issue 3, March 2015, Pages 397-406, <https://doi.org/10.1093/ejcts/ezu285>
- Birba R, Patel P, Aresu G, Asimakopoulos G. Minimally invasive direct coronary artery bypass versus off-pump coronary surgery through sternotomy. *Ann R Coll Surg Engl.* 2013 Oct;95(7):481-5. doi: 10.1308/003588413X13629960047119. PMID: 24112493; PMCID: PMC5827271.
- Liang, L., Liu, JJ., Kong, QY, et al. Comparison of early outcomes associated with coronary artery bypass grafting for multi-vessel disease conducted using minimally invasive or conventional off-pump techniques: a propensity-matched study based on SYNTAX score. *J Cardiothorac Surg* 17, 144 (2022). <https://doi.org/10.1186/s13019-022-01905-8>
- Bangalore S, Guo Y, Samadashvili Z, Blecker S, Xu J, Hannan E. Everolimus-eluting stents or bypass surgery for multivessel coronary disease. *N Engl J Med.* (2015) 372:1213-22. doi: 10.1056/NEJMoa1412168
- D'Ancona G, Vassiliades TA, Boyd WD, et al. Is hybrid coronary revascularization favored by cardiologists or cardiac surgeons? *Heart Surg Forum* 2002;5:393-5
- Holzhey DM, Jacobs S, Walther T, et al. Cumulative sum failure analysis for eight surgeons performing minimally invasive direct coronary artery bypass. *J Thorac Cardiovasc Surg* 2007;134:663-9.
- Modrau IS, Holm NR, Maeng M, et al. One-year clinical and angiographic results of hybrid coronary revascularization. *J Thorac Cardiovasc Surg* 2015;150:1181-6
- Loop FD, Lytle BW, Cosgrove DM, et al. Influence of the internal-mammary-artery graft on 10-year survival and other cardiac events. *N Engl J Med* 1986;314:1-6.
- Serruys PW, Morice MC, Kappetein AP, et al. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. *N Engl J Med* 2009;360:961-72
- Farkouh ME, Domanski M, Sleeper LA, et al. Strategies for multivessel revascularization in patients with diabetes. *N Engl J Med* 2012;367:2375-84.