

# Minimally invasive direct coronary artery bypass: preliminary results at University Medical Center of Ho Chi Minh city

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## **Abstract:**

**Background - Objectives:** In the recent years, minimally invasive direct coronary artery bypass (MIDCAB) is under rapid development worldwide. The number of MIDCAB is growing dramatically in developed countries. This study aimed for the assessment of indications, techniques, and short-term result of MIDCAB and the experience in building a new technique in our center.

**Method:** We reported 4 patients who underwent minimally invasive coronary artery bypass at the University Medical Center of Ho Chi Minh city.

**Results:** 4 patients were operated with MIDCAB procedure. Mean ICU time was 1.4, mean mechanical ventilation time was 5.7 hours, and in-hospital time was 8.4 days. In postoperative time, patients recovered quickly; they experienced less pain than normal and returned to normal activities in a short time.

**Conclusions:** In our very first experiences with MIDCAB procedure, the early outcomes are satisfactory with low morbidity and no mortality. MIDCAB is safe and feasible, provided that patient selection is good and safety protocols are followed.

**Keywords:** coronary artery bypass, left minithoracotomy, minimally invasive cardiac surgery.

**Classification number:** 3.2

## **Background**

First described in 1910 by Alexis Carrels, coronary artery bypass grafting is one of the three major areas of adult heart surgery. The first selected graft is the internal thoracic artery. In 1955, vein grafts were put into use. In 1958, off-pump coronary surgery was first performed by Longmire [1].

Coronary artery disease has so far

been widespread, with a long-term survival of around 77% after 10 years (Domburg, et al.) [2].

Currently, in Vietnam, coronary artery bypass surgery has been widely performed in heart centers. At University Medical Center of Ho Chi Minh city, coronary artery bypass surgery has become a routine surgery.

Technically, this is one of the most

meticulous surgery, requiring the surgeon to not only have good strategies and be knowledgeable, but also have good skills.

The classic opening is the median sternotomy. Internal thoracic artery, saphenous vein, gastroepiploic artery have been used as graft materials. Surgery is performed with cardiopulmonary bypass (cardiac arrest) or off-pump technique (using a specially designed holder to fix the heart), or under the support of cardiopulmonary bypass without cardiac arrest.

The advantage of median sternotomy is a large surgical field, where the surgeon can operate easily and conveniently. However, this approach also has its own disadvantages.

One of the disadvantages of median sternotomy is the risk of postoperative deep sternal wound infection. In coronary artery bypass surgery via median sternotomy, there is an increase in the risk of sternal dehiscence. In addition, there are general drawbacks such as postoperative pain, slower recovery than less invasive surgery, increased hospital stay, and increased costs [3]. Since the internal thoracic artery is the first choice graft, when this artery is harvested, blood supply to the sternum decreases, leading to increased risk of infection and reduced bone healing. From 2005

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to 2010 in India, Okonta, et al. found that the mean length of stay for sternal wound infection was  $23.5 \pm 8.9$  days, which was much longer than the length of hospital stay after surgery without these complications [4].

However, until now, total arterial coronary artery bypass grafting is still the gold standard for cases of triple vessels disease, having the best long-term graft patency, long-term mortality, as well as lower incidence of cardiovascular events than other methods [5].

Currently, triple vessels disease with stentable lesions in the left circumflex and right coronary systems in high-risk patients (elderly, obesity, diabetes mellitus), median sternotomy and bilateral internal thoracic arteries harvesting may increase the postoperative mortality and complications, particularly deep sternal wound infection and long recovery time of the patient. Therefore, the trend of minimally invasive surgery has opened a new direction for these patients: coronary intervention in combination with surgery.

### Method

A total of 4 patients underwent MIDCAB surgery via left anterior thoracotomy at the Department of Cardiovascular surgery of the University Medical Center of Ho Chi Minh city from January 2017 to October 2017 (Table 1).

In four patients, there were three cases of chronic total occlusion of the Left anterior descending artery (LAD), one early stent stenosis of LAD in relatively young patients (54 years), the patient and his family chose less invasive coronary artery bypass surgery. All patients underwent MIDCAB via left anterior thoracotomy.

### Techniques

Patients were placed in supine position with a cushion under the left scapula to facilitate exposure; two first patients were anesthetized with double lumen endobronchial tube selective left lung isolation, single lumen endotracheal tube was used for the following two patients. An incision of 7 cm was made, intercostal space was selected depending on the lesions on the LAD. If lesions of

the LAD are at the first or the middle part, we choose the IV intercostal space (ICS), if LAD lesions are at the third part, we choose the fifth ICS (Fig. 1).

A special thoracic retractor (Geister's Thoragate) is specially designed to harvest the left internal mammary artery (LIMA). The goal is to harvest to the origin of the artery in order to avoid stealing blood from the collateral branches of the internal thoracic artery to the chest wall. The median duration of chest harvesting in four patients was 46.5 minutes. The two early patients were longer than the two following ones.

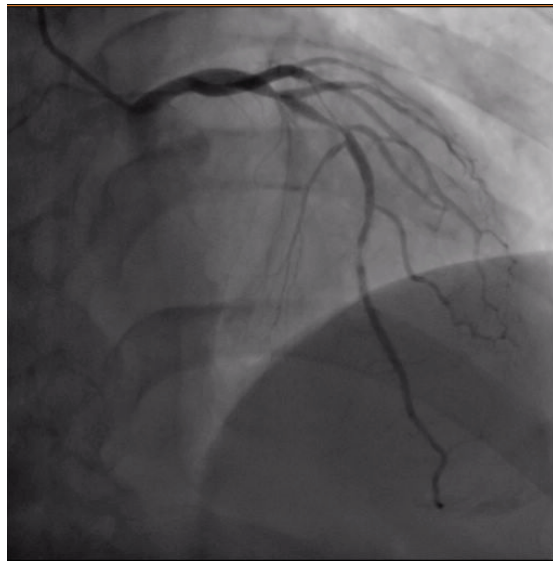
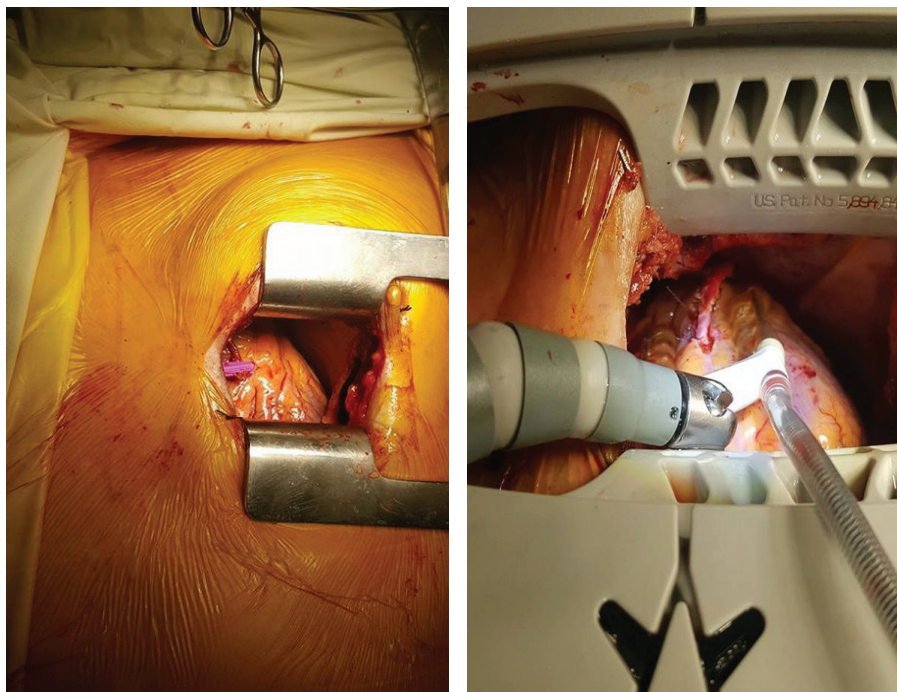
After being harvested from the chest wall, the LIMA was cut down to check the blood flow and ensure no dissection or damage that affect the flow. The pericardium was opened at the level of the LAD. Traction sutures were placed to give better exposure to this artery. In the first two cases, we used supported cardiopulmonary bypass from the femoral vessels; in the latter two cases, we performed the complete off-pump LIMA-LAD anastomosis (Figs. 2, 3).



Fig. 1. Thoragate retractor (left) and surgeon's position (right).

**Table 1. Description of the variables.**

Variables	Results
Number of patients	4
Mean ventilation time (hour)	5.7
Mean ICU time (days)	1.4
Mean postoperative time (days)	8.4

**Fig. 2. LAD stent restenosis.****Fig. 3. LIMA harvested (left) and LIMA - LAD anastomosis (right).**

After performing the anastomosis, hemostasis was checked, a chest tube and a pericardial drainage were placed and the thoracotomy was closed.

### Results and discussions

By the 1980s, coronary artery bypass surgery had been established as a widespread and safe surgery. Since the 1990s, less invasive cardiac surgery has been widely accepted to meet the needs of patients (less traumatic, cosmetic) and the requirements of economic benefits (rapid recovery, reduction in hospitalization time).

As a result, new surgical instruments and peripheral cardiopulmonary bypass techniques have been developed (outside the thoracic aorta and the vena cava) to help create a limited access to the surgical field while maintaining the quality of the operation.

Minimally invasive cardiac surgery uses a variety of approaches such as ministernotomy, minithoracotomy and small trocar holes (total endoscopic and robotic surgery). This type of cardiac surgery reduces bleeding, pain, and the incidence of surgical site infections. Additionally, it helps patients recover quickly, reduces hospital stay, and reduces medical costs. Many studies have shown that all of the techniques performed in cardiac surgery with classic sternotomy are applicable in less invasive cardiac surgery without altering the prognosis of the patient, even when performed for patients with high surgical risk.

A meta-analysis of P. Modi, et al. from 43 studies published between 1998 and 2005 (two RCTs, 17 case-control studies, 24 cohort studies), found that compared to conventional full sternotomy, minimally invasive cardiac surgery did not increase mortality, and postoperative cerebrovascular accident. Reoperation due to bleeding was significantly higher but tended to decrease with time. Moreover, infection was significantly lower (1.8% vs. 7.7%,  $p = 0.03$ ). The level of postoperative pain was reduced, and the recovery time to normal activities was faster (4 weeks vs. 9 weeks,  $p = 0.01$ ) [6].

In 1998, Duhaylongsod, et al. described LIMA harvesting through a small thoracotomy with thoracic



endoscopy, which contributed to put the first steps in minimally invasive coronary artery bypass surgery [1].

The LIMA-LAD anastomosis has been shown to have a very good durability in treating modalities for this very important coronary artery. If the artery is severely stenosis and the lesion is complicated, and unstentable, harvesting the LIMA via a small thoracotomy with the usage of a special retractor helps avoid the median sternotomy. This is especially beneficial for patients with type 2 diabetes, obesity as it decreases chest instability and the risk of mediastinal infections.

According to Y. Ling, et al.'s report on minimally invasive coronary artery bypass surgery, the median duration of LIMA harvesting was 43 minutes, mean mechanical ventilation time was  $9 \pm 7$  hours, mean ICU time was  $24 \pm 18$  hours, the mean units of red blood cell transfused was  $0.79 \pm 1.58$ , and 30 day mortality was 0.5% [7] (Table 2).

R. Birla, et al. conducted a research to compare the minimally invasive coronary artery bypass surgery and the conventional

off-pump coronary artery bypass (OPCAB) grafts on single vessel disease, which demonstrated no difference in mortality, recurrent myocardial infarction, postoperative cerebrovascular accident, atrial fibrillation, and reoperation [8] (Tables 3, 4).

At the moment, minimally invasive coronary artery bypass surgery is indicated for the following cases:

- Single vessel disease of LAD and/or diagonal branches with complex, unstentable lesions.
- Stent restenosis of LAD, unstentable lesions.
- Three-vessel disease in high-risk patients, unstentable, revascularisation of the most important cardiac muscle part perfused by LAD is indicated.
- Three-vessel disease in high-risk patients and it is feasible to stent the LCx and RCA.
- Patients with coronary artery disease who wish to undergo minimally invasive surgery on the LAD in combination with stent placement in the other branches (right coronary arteries and arteries) [7].

**Table 2. In-hospital clinical outcomes and 30-day mortality (N = 200).**

	MIDCAB (n=138)	Hybrid (n=62)	Total (N=200)
30-day mortality, N (%)	1 (0.7 %)	0 (0.0 %)	1 (0.5 %)
Perioperative MI, N (%)	1 (0.7 %)	0 (0.0 %)	1 (0.5 %)
Duration of mechanical ventilation, hour	$9.93 \pm 8.65$	$7.79 \pm 4.43$	$9.27 \pm 7.65$
LOS in ICU, hour	$24.17 \pm 17.83$	$24.48 \pm 18.03$	$24.27 \pm 17.85$
PRBC, units	$0.86 \pm 1.63$	$0.61 \pm 1.47$	$0.79 \pm 1.58$
PAF, N (%)	10 (7.2 %)	4 (6.5 %)	14 (7.0 %)
Stroke, N (%)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Renal failure, N (%)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)
Incision complications, N (%)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)

ICU: intensive care unit; LOS: length of stay; MI: myocardial infarction; PAF: postoperative atrial fibrillation; PRBC: packed red blood cell.

**Table 3. Intensive care unit length of stay for MIDCAB and OPCAB groups.**

	MIDCAB (n=74)	OPCAB (n=78)	p-value
Length of stay	38.36 hours	47.87 hours	>0.5
Ventilation duration	5.04 hours	5.35 hours	>0.5

**Table 4. Comparison of early postoperative outcomes between MIDCAB and OPCAB groups.**

	MIDCAB (n=74)	OPCAB (n=78)	p-value
Mortality	0 (0%)	0 (0%)	-
Reoperation for bleeding	0 (0%)	2 (2.7%)	0.2
Atrial fibrillation	17 (22.9%)	12 (15.4%)	0.3
Wound infection	4 (5.4%)	2 (2.7%)	0.4
Cerebrovascular accident	2 (2.7%)	0 (0%)	0.1

### Collaboration between Cardiac surgeons and Interventional Cardiologists:

Cardiologists play an important role in the selection of patients with minimally invasive coronary artery bypass surgery based on the indications. The collaboration between cardiac surgeons and interventional cardiologists to select the patient ensures patient safety, and provides a new option for patients, especially those at high risk for surgery.

### Conclusions

In our very first experiences with MIDCAB procedure, the early outcomes are satisfactory with low morbidity and no mortality. MIDCAB is safe and feasible, provided that patient selection is good and safety protocols are followed.

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