

# MINIMALLY INVASIVE DIRECT CORONARY ARTERY BYPASS: COORDINATION STRATEGY BETWEEN SURGEON AND CARDIOLOGIST

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## ABSTRACT

**Background:** Minimally invasive direct coronary artery bypass (MIDCAB) is under rapid development worldwide in recent years. The number of MIDCAB is growing dramatically in developed countries.

**Objectives:** To assess of indications, techniques and short term result of MIDCAB and the experience in building a new technique in Cardiovascular Surgery Department – University Medical Center of Ho Chi Minh City.

**Method:** We reported 2 patients underwent minimally invasive coronary artery bypass at the University Medical Center at Ho Chi Minh City.

**Results:** 02 patients were operated with MIDCAB procedure. ICU time was 1 and 2 day, mechanical ventilation time was 5 hours and 6 hours, in-hospital time was 8 days and 10 days, respectively. 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 though safe and feasible, provided that patient selection is good and safety protocols are followed.

**Key words:** Minimally invasive cardiac surgery, left minithoracotomy, coronary artery bypass.

## I. OVERVIEW

Coronary artery bypass surgery is one of the three major areas of adult cardiac surgery. Coronary artery bypass surgery was first described in 1910 by Alexis Carrel. The first selected artery is the internal thoracic artery. By 1955, saphenous vein was used as a secondary graft. In 1958, off-pump coronary surgery was first performed by Longmire [1].

Up to now, coronary artery disease has become a worldwide disease, with a survival rate of about 77% after 10 years (Domburg et al.) [2].

Currently in our country, coronary artery bypass surgery has been widely done in centers of adult

cardiac surgery. At the University Medical Center of Ho Chi Minh City, coronary artery bypass surgery has become routine for years.

Technically, this is one of the meticulous surgery, requiring not only good strategies and knowledge, but also good skills.

Conventional approach is the median sternotomy. Grafts of choices consist of the internal thoracic arteries, saphenous veins, radial artery and gastroepiploic artery. Surgery is performed with cardiopulmonary bypass (cardiac arrest) or off-pump surgery, or under the support of cardiopulmonary bypass but on a beating heart.

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

One of the disadvantages of conventional sternotomy is the risk of postoperative deep sternal wound infection. In coronary artery bypass surgery with full sternotomy, the risk mediastinitis is even higher, postoperative pain, slow recovery are also major disadvantages of this approach. These disadvantages increase the length of hospital stay and the medical costs [10]. Because coronary artery surgery primarily uses the thoracic artery as a graft, when the internal thoracic artery is removed, blood supply to the sternum decreases, leading to increased risk of infection and reduced bone healing. Okonta et al., from 2005 to 2010, found that the mean length of hospital stay for a sternal wound infection was 23.5 +/- 8.9 days, much longer than the length of conventional bypass surgery hospital stay [3].

However, until now, coronary artery bypass grafting is still the gold standard for cases of triple coronary artery disease, which has the best graft patency and Long-term mortality and cardiovascular events are lower than in other methods [8].

Currently, in high-risk patients (older age, obesity, diabetes mellitus) with 3 vessels disease and an interventionable left circumflex and right coronary artery. Conventional coronary artery bypass with harvesting of two internal thoracic arteries may increase the mortality and morbidity in particular, mediastinitis, which results in patient's long recovery. Therefore, the trend of minimally invasive has created a new direction for the high-risk patients: coronary intervention combined with surgery.

**Objectives:** To assess of indications, techniques and short term result of MIDCAB and the experience in building a new technique in Cardiovascular Surgery Department – University Medical Center of Ho Chi Minh City.

## **II. MATERIALS AND METHOD**

**2.1. Subjects:** We described two cases of coronary artery disease with intervention indication and were operated with minimally invasive direct coronary artery bypass at the University Medical Center of Ho Chi Minh City.

**2.2. Method:** case report

### **Case file 1:**

Patient's name: Nguyen Van L., 54 y.o

Address: Ia Kring – Pleiku – Gia Lai.

Admission No.: 17 – 0020401.

Chief complaint: Stable angina.

Background:

- Left anterior descending artery (LAD) stenosis, stented with 2 Drug – eluting stents in September 2015 in the Department of Cardiology, University Medical Center of Ho Chi Minh City.

- Hypertension.

Admission coronary angiography: 90% restenosis in stent LAD I and 80% in stent LAD II.

Preoperative echocardiography: Normal heart valves, normal left ventricular systolic function (Simpson EF 60%).

ECG: Sinus rhythm, 80 times / min. Flat T wave in the chest leads.

PA chest x-ray: Normal.

Patients underwent surgery on April 18, 2017: We performed minimally invasive direct coronary artery bypass using a small left thoracotomy supported by femoral – femoral cardiopulmonary bypass without arresting the heart. Left internal thoracic artery was used as the graft and the anastomosis was done at the far part of LAD.

Surgical time is 2 hours 45 minutes, cardiopulmonary bypass time is 40 minutes.

At the ICU, the patient was extubated after 6 hours with a fast tract protocol, good hemodynamic parameters, good urine output, no arrhythmia, no bleeding. Patient was transferred to normal room after 1 day in the ICU.

Discharge on postoperative day 5.

Echocardiography before discharge: Normal

## Hue Central Hospital

heart valves, good cardiac function, no cardiac dyskinesia, EF 65%.

Patient has got postoperative consultation at our Hospital. There is no chest pain on exertion, he soonly got back to his daily activities.

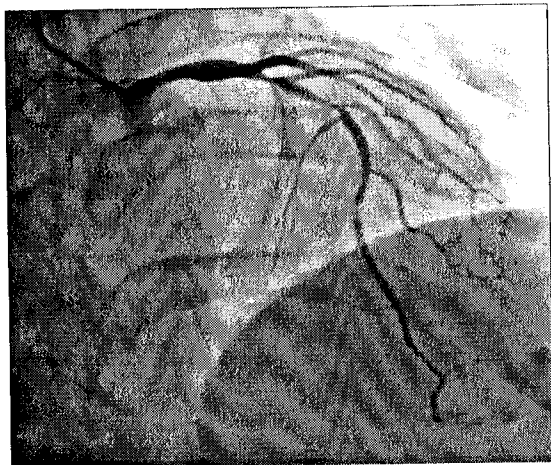


Figure 1: LAD stents restenosis.

### Case file 2:

Patient's name: Nguyễn Chiên T., 65 y.o

Address: Ward 10 – District 6 – HCM City

Admission No.: 17 – 0124328.

Chief complaint: Stable angina.

Coronary angiography: Small right coronary, 90% LAD I and 95% LAD II stenosis, 60% PDA stenosis, PDA from LCx (Left dominant coronary circulation).

Preoperative echocardiography: Normal heart valves, good left ventricular systolic function (EF 56% by Simpson).

ECG: Sinus rhythm, 72 times / min. Flat T wave in the chest leads.

PA chest x-ray: Normal.

Patients underwent surgery on May 09, 2017: We performed minimally invasive direct coronary artery bypass using a small left thoracotomy supported by femoral – femoral cardiopulmonary bypass without arresting the heart. Left internal thoracic artery was used as the graft and the anastomosis was done at the far part of LAD.

Surgical time is 2 hours 55 minutes, cardiopulmonary bypass time is 35 minutes.

At the ICU, the patient was extubated after 5 hours with a fast tract protocol, good hemodynamic parameters, good urine output, no arrhythmia, no bleeding. Patient was transferred to normal room after 2 day in the ICU.

Discharge on postoperative day 6.

Echocardiography before discharge: Normal heart valves, good cardiac function, no cardiac dyskinesia, EF 60%.

Patient has got postoperative consultation at our Hospital. There is no chest pain on exertion, he soonly got back to his daily activities.

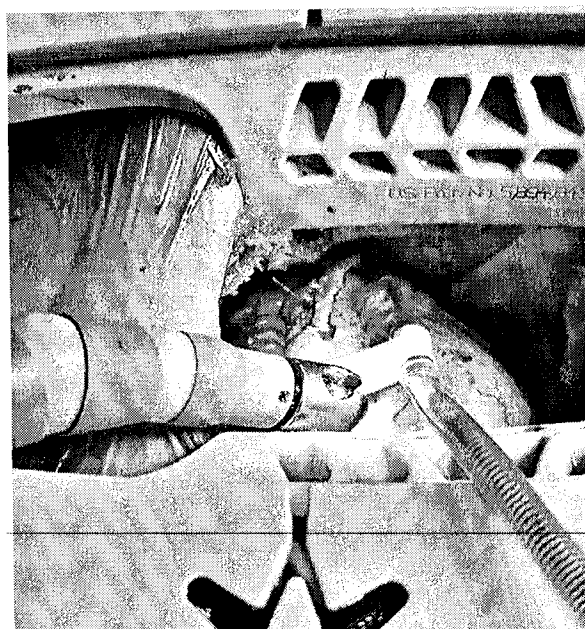
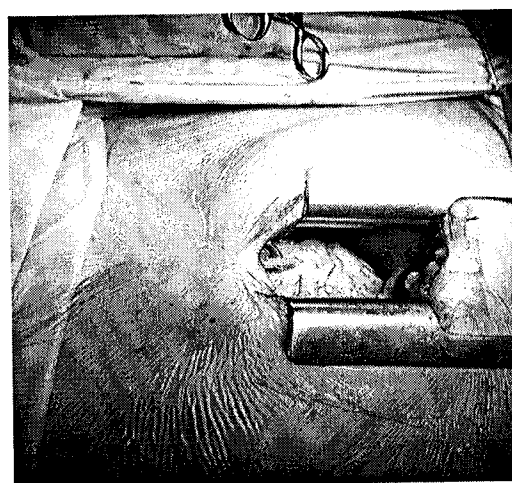


Figure 2: Left internal thoracic artery (Left) and LIMA – LAD anastomosis (Right)

### III. DISCUSSION

By the 1980s, coronary artery bypass surgery had become a routine and safe surgery. Since the 1990s, minimally invasive cardiac surgery has been widely accepted to satisfy patients' needs (less stressful, cosmetic) and economic benefit requirements (rapid recovery, reduced length of hospital stay).

Consequently, many instruments, devices, as well as cardiopulmonary bypass techniques have been developed in other locations (outside the thorax) to help approaching the operating area from a small surgical field and still ensure the quality of surgery as with conventional sternotomy.

Minimally Invasive Cardiac Surgery uses a variety of approaches such as the ministernotomy, the right lateral minithoracotomy and small trocar holes (endoscopic and robotic surgery). This type of surgery have a lot of advantages: Lower bleeding rates, less pain, and a reduction in the incidence of wound

infections. These can help patients recover quickly, reduce the length of hospital stay, and medical costs. Many studies have shown that all of the techniques available in conventional cardiac surgery with full sternotomy are applicable in less invasive cardiac surgery without compromising the prognosis of the patient, even with high risk patients.

A meta-analysis of Paul Modi et al., analyzing 43 studies published between 1998 and 2005 (two RCTs, 17 case-control studies, 24 cohort studies), showed that minimally invasive cardiac surgery did not increase mortality and postoperative cerebrovascular accident comparing with conventional cardiac surgery. The rate of reoperation due to postoperative bleeding is significantly higher but tends to decrease in time. The incidence of 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 versus 9 weeks,  $p = 0.01$ ).

Table 1. Meta- analysis of outcomes

Outcome	No. of patients	No. of studies	Or/ WMD (95% CI)	P Value
Mortality	1641	6	0.46 (0.15 - 1.42)	0.18
Stroke	1801	6	0.66 (0.23 - 1.93)	0.45
CPB	871	8	25.81( 13.13 - 38.50)	<0.0001
XC	671	7	20.91( 8.79 - 33.04)	0.0007
Re-op for bleeding	1553	5	0.56 (0.35 - 0.90)	0.02
New onset AF	539	4	0.86 (0.59 - 1.27)	0.45
ICU stay	309	4	0.36(-0.080 - 0.08)	0.1
Hospital stay	350	5	0.73 (-1.52 - 0.05)	0.07

AF, atrial fibrillation, CPB, cardiopulmonary bypass time, ICU, intensive care unit, XC, cross clamp time.

In 1998, Duhaylongsod et al. described endoscopic LIMA harvesting[1].

The LIMA – LAD anastomosis has been shown to have the longest patency among all type of grafts [9]. In case of single vessel disease (LAD) but the anatomy complicated, coronary stenting is not feasible, LIMA harvesting through a small left thoracotomy using a specialized retractor,

especially in patients with type II diabetes, obesity, reduces the incidence of chest instability as well as the risk of mediastinitis and still have all the benefit of conventional LIMA harvesting.

According to Yunpeng Ling's article on minimally invasive coronary artery surgery, the average time to harvest LIMA was 43 minutes, the mean mechanical ventilation time was  $9 \pm 7$  hours, the ICU time was  $24 \pm 18$  hours, the average unit of transfused red blood cell was  $0.79 \pm 1.58$ , the 30 – day mortality was 0.5% [5].

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 ± 8.65	7.79 ± 4.43	9.27 ± 7.65
LOS in ICU, hour	24.17 ± 17.83	24.48 ± 18.03	24.27 ± 17.85
PRBC, units	0.86 ± 1.63	0.61 ± 1.47	0.79 ± 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

Birla et al. compared minimally invasive direct coronary artery bypass surgery and off pump conventional coronary artery bypass grafts in single vessel disease and showed no statistically significant differences in mortality, recurrent myocardial infarction, postoperative cerebrovascular accident, atrial fibrillation and reoperative surgery. [6].

Table 3: Intensive care unit length of stay for minimally invasive direct coronary artery bypass (MIDCAB)and off pump coronary

	MIDCAB (n=74)	OPCAB (n=78)	P= value
Length of stay	38.36 hours	47.87 hours	> 0.05
Ventilation duration	5.04 hours	5.35 hours	>0.05

Table 4: Comparison of early postoperative outcomes between minimally invasive direct coronary artery bypass ( MIDCAB) and off pump coronary artery bypass (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

Currently, minimally invasive direct coronary artery bypass surgery is indicated for the following cases:

- LAD stenosis and/or diagonal branch stenosis with complex anatomy, coronary stenting is not feasible.
- Restenosis of LAD stent without the ability to restent it.

- Three vessel disease in patients with high risk of surgery, coronary stenting is not feasible, and need to be reperfused of the most important region irrigated by LAD.

- Three vessel disease in patients with high risk of surgery and coronary stenting is feasible in LCx and RCA.

- Patients with three vessel disease who wish to undergo minimally invasive surgery on the LAD combined with stenting in the other coronary arteries. [5]

#### ***Cordination between Cardiologists and Cardiac surgeons***

Cardiologists play an important role in the selection of patients with minimally invasive coronary artery bypass surgery based on the

indications. The combination of patient selection between cardiologists and cardiac surgeons helps ensure patient safety, providing a new option for patients, especially in high risk population.

Our encouraging results in coordinating between the Department of Cardiology and the Department of Cardiovascular surgery is the premise to create close links between these two specialties to give patients the best option and highest benefits.

#### **IV. CONCLUSION**

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

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## **PRISE EN CHARGE ENDOVASCULAIRE DES THROMBOSES VEINEUSES PROXIMALES DES MEMBRES INFÉRIEURS AU STADE AIGU ET CHRONIQUE**

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Longtemps réservée aux seuls anticoagulants, la prise en charge thérapeutique des thromboses veineuses proximales, cave inférieure et des membres inférieurs, voit se développer de nouveaux outils endovasculaires de désobstruction. Au stade aigu, la thrombolyse pharmaco-mécanique associée au traitement par angioplastie de l'éventuelle obstruction causale sous-jacente permet de prévenir l'évolution vers le syndrome post-thrombotique et autorise la conservation de l'appareil valvulaire. Au stade chronique, la recanalisation endoluminale du segment ilio-fémoral et/ou cave inférieur occlus permet de soulager les symptômes du syndrome post-thrombotique et de limiter le risque de récurrence de thrombose veineuse profonde. Bien qu'apparentée au traitement endovasculaire de l'artériopathie oblitérante des membres inférieurs, la revascularisation endoluminale veineuse proximale, très exigeante, nécessite une formation spécifique. Une fois ces pré-requis techniques acquis, les résultats cliniques à court et moyen termes sont excellents avec des taux de perméabilité supérieurs à 90%, pour une morbidité extrêmement faible et une durée d'hospitalisation de 24 à 48h. Cependant, alors que la place de la désobstruction au stade chronique a prouvé son bénéfice dans de nombreuses études, celle de la désobstruction au stade aigu reste encore à être confirmée et se limitera probablement aux formes cliniques les plus graves.

**Mots clés:** Thromboses veineuses proximales, anticoagulants.