



## Case Report

# Surgical revascularization of the myocardium by minimally invasive access

Roger Yoel Conde Moncada <sup>1,a</sup>, Aldrix Josué Sisniegas Razón <sup>1,a</sup>

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### Authors' affiliation

<sup>1</sup> Instituto Nacional Cardiovascular,  
EsSalud, Lima, Peru.  
<sup>a</sup> Physician

### Correspondence

Roger Conde Moncada  
1109 Bolivia Avenue, Lima, Peru.  
+51 986544228

### Email

condemoncada@gmail.com

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### Conflicts of Interest

The authors declare no conflict of interest.

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## ABSTRACT

Median sternotomy is the gold standard access for surgical revascularization of the myocardium, but it is not complications free intervention, especially in patients with multiple comorbidities. Minimally invasive access offers the advantage of avoiding sternotomy, achieving a more accelerated postoperative recovery, with less hospital stay time and a higher level of satisfaction with quality of life. We present the case of a 49-year-old male patient, diabetic, hypertensive, smoker, with multiarterial coronary artery disease, very symptomatic, who underwent surgical revascularization by left mini-thoracotomy.

**Keywords:** Sternotomy; Thoracotomy; Coronary Disease (source: MeSH-NLM).

## Introduction

The long-term results of minimally invasive myocardial revascularization are similar to conventional myocardial revascularization since arterial grafts (left and right internal mammary) can be obtained by left thoracotomy. In addition, the performance of the bypasses, either with the support of extracorporeal circulation (ECC) or without ECC, does not change at all <sup>(1)</sup>. We present the first myocardial revascularization by left anterior mini-thoracotomy with internal mammary artery (IMA),

radial artery and saphenous vein with ECC support at the National Cardiovascular Institute (INCOR) in Lima Peru.

## Case report

A 49-year-old male patient with a history of hypertension, non-insulin-requiring type-2 diabetes mellitus and chronic smoking was admitted with one year of sickness characterized by functional class III angina and a positive stress test. Cardiac catheterization showed severe multiarterial coronary artery disease with lesions in the left main coronary artery (LMCA) (90%); anterior descending

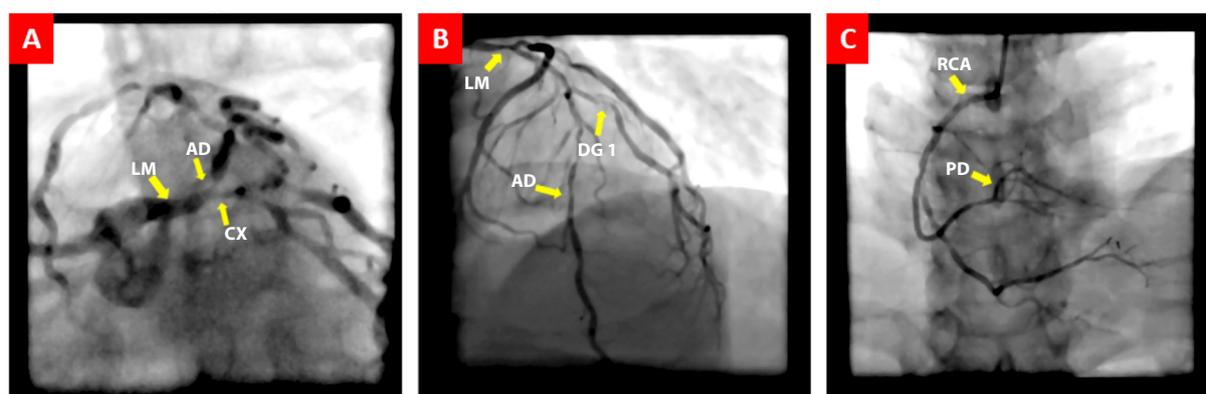
(AD) (80%); first diagonal (Dg) (70%); circumflex (CX) (80%); first marginal (Mg) (70%), and right coronary artery without lesions (**Figure 1**). Echocardiography showed a left ventricular ejection fraction of 62%, with no other relevant findings. Chest tomography, with and without contrast were normal.

In the operating room, selective intubation of the left bronchus was performed (with a double lumen tube), and the patient was positioned in the supine decubitus position with 30° elevation of the left hemithorax. Then, a left anterior thoracotomy was performed at the level of the fifth intercostal space in left clavicular midline (**Figure 2A**) to enter the pleural cavity with selective collapse of the left lung and thus be able to harvest the video-assisted left internal mammary artery, obtaining approximately 9 cm of its length (**Figure 3A and 3B**). In parallel, a radial artery graft was obtained from the right forearm (**Figure 2B**) and a segment of the right thigh saphenous vein (**Figure 2C**). Right femoral vessels were exposed for peripheral cannulation with high-flow arterial cannula N.º 21 and venous cannula N.º 25, followed by aortic clamping and cardiac arrest with Bretschneider solution. Then, aortocoronary anastomoses were performed with great saphenous vein to the first Dg, then from an inverted "Y" saphenous vein to the first Mg, and finally from IMA to the AD. The aorta was unclamped, and we progressively came out of ECC without any intercurrent. We performed a revision of haemostasis, transient epicardial pacing implantation and placement of left pleuropericardial drain N.º 32. Finally, the ribs were closed with plane closure up to the skin. The duration of ECC was 180 min and aortic clamping was 120 min. Total bleeding was 150 mL.

On leaving the operating room, the patient was extubated before being admitted to the postoperative care unit, with intravenous infusion of dobutamine and nitroglycerin in low doses and with minimal bleeding from the thoracic drainage. After 24 h, the pleuropericardial drain was removed and he was transferred to intermediate care. The following day, he was transferred to general care where a coronary angiogram was performed to check the patency of the coronary bridges (**Figure 3C**). He was discharged on the third day in general care with optimal medication.

## Discussion

The advantage of mini-thoracotomy access is that median sternotomy and infections of the operative site are avoided, there is better pain management, especially postoperative chronic pain, and there is also a shorter stay in the postoperative care unit, with prompt discharge, as has been demonstrated in different studies of large centers <sup>(2,3)</sup>. Surgery is recommended in diabetic patients and patients with a body mass index < 30 kg/m<sup>2</sup> and multiple comorbidities <sup>(4-6)</sup>. In contrast, this approach is contraindicated in emergencies, rib cage deformities such as *pectus excavatum*, severe pulmonary disease, an intramyocardial or calcified AD artery, or diffuse disease and peripheral arterial disease if ECC is planned <sup>(7)</sup>.



**Figure 1.** Pre-surgical cardiac catheterization. **(A)** Left coronary angiography in left oblique caudal projection showing severe lesion of distal LM and origin of AD with CX (yellow arrows). **(B)** Left coronary angiography in right oblique cranial projection showing severe lesion of LM, middle third of AD and proximal segment of first diagonal (yellow arrows). **(C)** Right coronary angiography in left oblique projection showing right dominance. LC and PD without lesions.

LM: left main, AD: anterior descending artery, CX: circumflex, Dg: diagonal, RCA: right coronary artery, PD: posterior descending

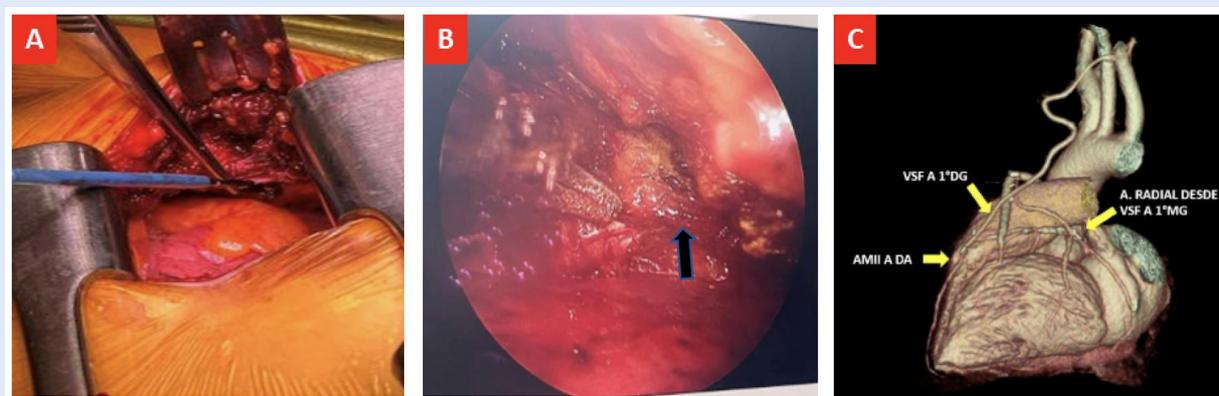


**Figure 2.** (A) Pre-surgical marking of access for left anterior mini-thoracotomy at the level of the left fifth intercostal space (5 cm in length). (B) Positioning of the patient to obtain the right radial arterial graft. (C) Dotted lines indicate the path of the right greater saphenous vein; right inguinal access for peripheral cannulation (black arrow).

The MIST study demonstrated that this surgical technique allows revascularization of multiple vessels, making it a safe alternative to sternotomy with respect to early and long-term postoperative morbidity and mortality, in addition to improving the patient's quality of life <sup>(2)</sup>. Ming *et al.* observed that graft durability was adequate, with a 10-year follow-up free of major adverse cardiac or cerebrovascular events of  $80 \pm 2.7\%$  and a survival of  $90.3 \pm 2.1\%$  <sup>(8)</sup>. Alberto *et al.* performed a 20-year follow-up in patients with minimally invasive revascularization and found a long-term survival of 80%, similar to the previous study <sup>(9)</sup>. Pieroze *et al.*, in a similar 20-year follow-up study, mention that minimally invasive revascularization in young patients and with low EuroSCORE (less than 5%) has good short- and long-term

results both in terms of survival and frequency of cardiac or major cardiovascular events <sup>(10)</sup>.

In Peru, at the Edgardo Rebagliati Martins Hospital, Quispe *et al.* published in 2017 a report of 30 cases of myocardial revascularization surgery by left mini-thoracotomy, 96.7% of cases was performed without ECC support, in 70% of cases only IMA to AD anastomosis was used; in 16.6% of cases, hybrid revascularization was performed (IMA to AD and stent to right coronary or Mg), and there was only one case of conversion to median sternotomy due to difficulties in surgical exposure. There were no cases of in-hospital mortality or excessive postoperative bleeding requiring re-exploration. The average length of hospital stay was 8.9 days <sup>(11)</sup>.



**Figure 3.** (A) Dissection of left internal mammary artery by video-assisted left anterior mini-thoracotomy. (B) Videothoracoscopy of proximal region of left internal mammary artery indicated with black arrow. (C) Post-surgical 3D angiogram, showing aortocoronary anastomosis of saphenous vein to first diagonal, with inverted "and" of radial artery to first marginal, and of left internal mammary artery in situ to LAD (indicated with yellow arrows).

In comparison with conventional surgery, minimally invasive revascularization does not show any difference in graft patency, being demonstrated with survival and follow-up free of major adverse cardiac or cerebrovascular events, as can be seen in the two studies by Alberto and Pieroze<sup>(9,10)</sup>. The only drawback of this procedure is that must be performed only in properly selected patients without any contraindication, as previously described<sup>(7)</sup>. Because is a complex surgery due to the approach, it requires an appropriate surgeon's learning curve to optimize the results, achieving a progressive increase in the total number of bypasses performed, a decrease in the operative time and less conversion to sternotomy<sup>(10)</sup>.

In the case presented, the implantation of arterial and venous grafts was performed with ECC support, since the experience without it is still scarce in our center<sup>(11)</sup>. Immediate extubation and an ICU stay of less than 24 h with a general care stay of 3 days were results comparable to those published in other centers<sup>(11,12)</sup>. In addition, patency of the grafts was confirmed with angiotomography prior to discharge. This surgical experience encourages us to increase the number of cases of revascularization by this technique in our institution.

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