

# First Report of Totally Robotically-Assisted Hybrid Coronary Artery Revascularization Combining RE-MIDCAB and R-PCI: Case Report

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## Abstract

A 62-year-old man presents to the Cardiology Department with a two years history of angina on exertion. Invasive coronary angiography revealed a severe three vessels coronary artery disease. The “Hybrid Heart Team” successfully performed a fully robotically-assisted hybrid revascularization combining RE-MIDCAB on the LAD and R-PCI on non-LAD lesions.

## Introduction

Hybrid Coronary Revascularization(HCR) with arterial grafts to the left anterior descending artery (LAD) and percutaneous coronary interventions for non-LAD lesions have been shown excellent graft patency rates and long-term results. This approach is a feasible strategy in selected patients with multivessel coronary artery disease<sup>1</sup>.

Robotically enhanced-minimally invasive direct coronary artery bypass (RE-MIDCAB) is an endoscopic approach with robotic harvesting of the left internal mammary artery(LIMA) followed by hand-sewn anastomosis under direct vision to the LAD on the beating heart (**Fig.1A**) . Robotically-assisted PCI (R-PCI) is a novel approach in interventional cardiology, where operators perform PCI controlling guidewires and catheter devices remotely (**Fig.1B**) .

## Case Report

This case report highlights the feasibility of treating a patient with a full robotically hybrid revascularization strategy. We report, a case of fully Robotically-Assisted HCR. RE-MIDCAB surgery, combined with R-PCI.

A 62-year-old man presents with a two years history of typical stable angina on exertion.

The patient has a history of arterial hypertension, hyperlipidemia, obesity (BMI 31kg/m<sup>2</sup>), insulin-dependent diabetes mellitus (hemoglobin A<sub>1c</sub> of 8.4%), and previous smoking until 2012.

Physical examination was normal. Resting echocardiography showed a preserved left ventricular ejection fraction (biplane 60%) without wall motion abnormalities. A cycle ergometer stress test was submaximal and hence inconclusive to rule out CAD.

Invasive Coronary Angiography (ICA) revealed a severe three-vessel disease. Multiple atherosclerotic lesions were present with an 80% focal stenosis in the middle RCA (**Fig.2A**) , a 70-80% focal stenosis in the proximal LCx (**Fig.2B**) , and diffuse and extensive lesions of the LAD (**Fig.2C**) . The anatomical SYNTAX Score was 15.

A hemodynamic evaluation of the lesions was performed using a Fractional Flow Reserve (FFR) with a pullback maneuver, in this way it is possible to evaluate the distribution of epicardial resistance to determine CAD pattern (focal or diffuse CAD)<sup>2</sup>. The hyperemic Pullback Pressure Gradient (PPG), was used to quantify the CAD pattern<sup>3</sup>. The FFR measurement in the LAD showed an FFR value of 0.75 with a PPG value of 0.40(**Fig.2D** ).

## Management

Following a discussion in the Heart team, a hybrid robotically-assisted revascularization was proposed to the patient. First, the RE-MIDCAB (DaVinci X Surgical System, Intuitive Surgical, Sunnyvale, USA), robotically-assisted harvesting of a pedicled LIMA followed by an end-to-side anastomosis to LAD, was performed via a left non-rib spreading mini-thoracotomy (**Video 1**) . On the 2<sup>nd</sup> post-operative day, the staged R-PCI revascularization was performed. The LIMA-LAD anastomosis was assessed by coronary angiography before PCI, confirming a good quality of the bypass (**Fig.3A**) . Then, R-PCI was performed using the CorPath GRX Robotic-PCI System (**Fig.3B**)(**Video 2**) . A Drug-Eluting Stent (Abbott Sierra 3.0 x 33 mm) was placed on the RCA (**Fig.3C**) and a long Drug-Eluting Stent (Biotronik, Orsiro Mission 3.0 x 40 mm) was placed from LCx to the first obtuse marginal branch (OM1)(**Fig.3D**)(**Video 3**) , achieving an excellent angiographic result. The postoperative course was uneventful and the patient was discharged on the 3<sup>rd</sup> post-operative day.

A first outpatient contact 6 weeks after the procedure the patient remains free from angina and without any adverse event.

## Discussion

Coronary artery bypass grafting (CABG), mainly utilizing multi-arterial conduits, is the best therapeutic strategy for patients with diabetes and multivessel CAD. The use of LIMA as a graft to the LAD has been shown to have excellent long-term results in terms of patency, event-free survival, and relief of angina in patients undergoing coronary revascularization. On the other hand, the disadvantages of CABG are epitomized by the invasiveness of the sternotomy, the use of cardiopulmonary bypass, and other frequent complications (bleeding, atrial fibrillation, and stroke) that results in prolonged hospitalization<sup>4,5</sup>.

As a result, the search towards more minimally invasive CABG techniques has known a long history. Total endoscopic approach with robotically-assisted harvesting of the internal mammary artery and anastomosing to the LAD on beating heart through a mini-thoracotomy is a well-known approach in expert centers. The main benefits of RE-MIDCAB are related to the reduction of typical complications of surgery while increasing patient satisfaction paired with excellent long-term graft patency<sup>6</sup>. If the advantages of using multi-arterial conduits are well known, the use of saphenous vein grafts (SVGs) has shown a high incidence of failure compared to ischemia-driven multivessel PCI. PCI is less invasive and offers a reduced risk of immediate complications coupled with a lessening of the length of stay<sup>7</sup>.

In the field of interventional cardiology, R-PCI is a novel and emerging approach. The interventional cardiologist can perform PCI using controls for rotational and longitudinal movements of the coronary guidewire, guide catheter, and for advancement and retraction of balloons and stents (**Video4**) . Several studies have corroborated the safety and efficacy of R-PCI for the treatment of simple and complex lesions (CORA-PCI study)<sup>8</sup>.

## Conclusions

This case shows the feasibility and safety of HCR in selected patients with multivessel CAD, highlighting how this hybrid technique combines the advantages of surgical and percutaneous revascularization, both guided by robotic techniques, eliminating at the same time some of the disadvantages of both procedures. Moreover, the use of RE-MIDCAB graft of the LIMA to the LAD and R-PCI to treat non LAD lesions could lead to additional benefits in optimizing patient outcomes.

This case report of robotically-enhanced hybrid revascularization is an example of a search towards a “value-

based cardiovascular care” in which the enhanced outcome mattering to the patient together with the cost reduction through shortening of hospitalization and reduction of well-known complications are the capital elements of the equation.

## References

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## Figures

Figure 1



Figure 2

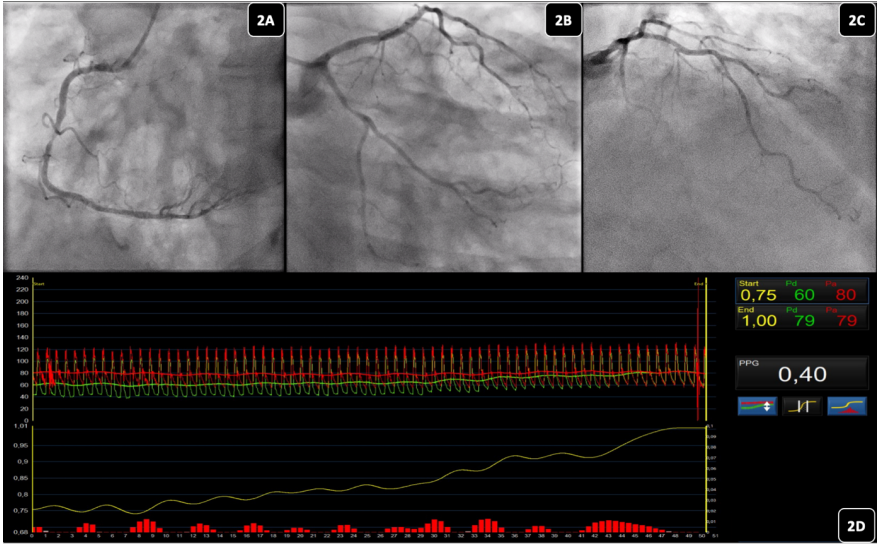


Figure 3

