

# CORONARY HYBRID REVASCULARIZATION UTILIZING ROBOTICALLY-ASSISTED CORONARY ARTERY BYPASS GRAFTING



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## Introduction

Full revascularization remains the goal for patients with multivessel coronary artery disease. The hybrid approach to coronary artery revascularization combines minimally invasive direct coronary artery bypass surgery (MIDCAB) of the left anterior descending artery (LAD) with percutaneous coronary intervention (PCI) of the remaining diseased coronary arteries. Traditional MIDCAB involves harvesting the left internal thoracic artery (LITA) through a small left anterior thoracotomy or lower hemisternotomy incision which is then sewn directly to the LAD.

Surgical revascularization of the LAD with the LITA is the major determinant of long-term survival for patients.[1] MIDCAB has been demonstrated to be superior for isolated lesions of LAD with excellent mid-term results.[2] This technique which avoids the use of cardiopulmonary bypass (CPB) avoids the risks associated with systemic inflammatory mediators and decreases the incidence of coagulopathy. [3-5] MIDCAB provides better recovery of pulmonary function [6] and patients experience less post-operative pain with a quicker return to normal activity. [7]

We sought to investigate if a minimally invasive strategy of coronary revascularization employing a staged percutaneous coronary intervention (PCI) and robotically-assisted MIDCAB could achieve the same benefits but with quicker patient recovery.

## Methods

Between 1/2002 and 9/2002, 4 patients underwent staged PCI followed by robotically assisted MIDCAB. All patients were male, mean age was 59 and pre-operative EF was 50%. PCI was performed through a femoral artery puncture and a 6F sheath. The right coronary artery (RCA) and left circumflex artery (LCX) underwent PCI when appropriate. All patients received intravenous unfractionated heparin (70 IU/kg body weight) before PCI. It was the operators' discretion to give aspirin, Clopidogrel, or glycoprotein IIb/IIIa receptor antagonists.

Fentanyl, midazolam, isoflurane, oxygen and muscle relaxant were used as general anesthetic in all cases. Robotic MIDCAB was performed using the DaVinci™ Surgical System to mobilize and prepare the LITA from the chest wall as well as to open the pericardium and identify the LAD. A single vessel LITA to LAD anastomosis was then performed off-pump through a limited 6cm incision. All patients received Eptifibatid post-PCI and Clopidogrel which were started 18-24 hours post-operatively.

## Results

An average of 1.5 PCIs were performed per patient. Robotic MIDCAB was performed on average 42 hours after PCI. Average total robotic port placement and LITA harvest time were 1.9 hours. There was one conversion to an on-pump sternotomy because of an intramyocardial LAD. All patients undergoing MIDCAB were extubated in the operating room. No patients required a blood transfusion and there were no episodes of post-operative atrial fibrillation. Length of stay averaged 4 days. At an average of 4.3 months follow-up, all patients are alive and well and no patients have had recurrent angina or a myocardial event.

## Discussion

Our institution's initial experience with hybrid revascularization utilizing robotically-assisted CABG has been very favorable. Our patient population tolerated the procedure well and although sample size was too small for formal statistical analysis, preliminary assessment opens the door for future development of this technique.

Hybrid revascularization provides several advantages over conventional CABG especially in patients with comorbidities that would make them unlikely to tolerate CPB. LITA to LAD grafting can be accomplished without the complications associated with CPB and traditional sternotomy. In previous studies, MIDCAB patients have demonstrated a shorter hospital length-of-stay and a quicker return to work compared to conventional CABG.[8]

Many questions still remain regarding the future of hybrid revascularization. The optimal time period between PCI and MIDCAB has yet to be determined. The technology of PCI is rapidly advancing with potentially wider application of antimitabolite-coated stents. Robotic cardiac surgery is also being developed in this country to allow for totally endoscopic LITA to LAD grafting. Hybrid revascularization combines the best current application of both interventional and surgical techniques. The future equilibrium is likely to change as these two minimally invasive techniques develop.

## Conclusion

A hybrid strategy employing staged PCI and robotically-assisted MIDCAB is a safe and effective minimally invasive technique that provides full revascularization. Long-term follow-up will be necessary to confirm possible survival benefits of this approach.

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**Circumflex lesion seen on angiography before intervention**



**Circumflex vessel after angioplasty and placement of a 4.5mm x 13mm Stent**



**Lesion in proximal left anterior descending artery awaiting MIDCAB**



**Surgeon's control console for DaVinci Robot**



**Arms of the Robot performing LITA take-down prior to mini-sternotomy**