

Treatment of Double Vessel Coronary Artery Disease by Totally Endoscopic Bypass Surgery and Drug-Eluting Stent Placement in One Simultaneous Hybrid Session

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ABSTRACT

Hybrid coronary artery revascularization is a combination of minimally invasive coronary artery surgery and catheter-based coronary intervention. Hybrid procedures enable adequate revascularization of patients with multivessel coronary artery disease without complete opening of the chest and with the advantage of the most durable option, a left internal mammary artery (LIMA) graft is placed to the left anterior descending (LAD) artery. The hybrid concept is gaining renewed interest because totally endoscopic LIMA to LAD placement has become feasible and because drug-eluting stents in non-LAD targets may be competitive even for arterial bypass grafts. Simultaneous hybrid procedures would be desirable. We report on a case in which robotic totally endoscopic LIMA to LAD grafting using the da VinciTM telemanipulation system was combined with placement of a rapamycin coated stent to the right coronary artery in one single procedure.

INTRODUCTION

Recent advances in endoscopic coronary artery bypass surgery as well as current development in drug-eluting stent technology have led to a renewed interest in coronary hybrid procedures. In these interventions minimally invasive placement of a left internal mammary artery graft to the left anterior descending artery (LAD) is combined with catheter-based intervention at a non-LAD target. The majority of hybrid operations have so far been carried out in a staged manner. The development of combined coronary interventions poses logistic challenges. We report on a case in which completely endoscopic left internal mammary artery (LIMA) to LAD grafting was combined with drug-

eluting stent placement to the right coronary artery in a single session.

CASE REPORT

A 66-year-old male patient presented to our hospital in angina CCSC III. His two cardiac risk factors were hypertension and a positive family history of coronary artery disease. There were no significant comorbidities. Coronary angiography revealed a 99% type C stenosis of the proximal LAD, not suitable for a percutaneous interventional procedure, a 99% proximal stenosis of a very small diagonal branch, and two 80% type A stenoses of the right coronary artery. The left ventriculogram showed anterolateral hypokinesis and a left ventricular ejection fraction of 60%.

Surgical Method

The patient was intubated using a double lumen tracheal tube, he was positioned in a right lateral decubitus position. Under single lung ventilation, the da VinciTM (Intuitive Surgical, Sunnyvale, CA) telemanipulation system was placed above the patient and a camera port was introduced into the 5th left intercostal space in the anterior axillary line. In addition, instrument ports were introduced into the 3rd and 7th intercostal spaces in the mid-clavicular line. The left internal mammary artery was harvested endoscopically. In parallel, a remote access perfusion system ESTECH RAPTM (ESTECH, Danville, CA) was introduced into the thoracic aorta through the femoral artery. Venous drainage was by a cannula placed into the right atrium through the left femoral vein. After opening of the pericardium, the LAD was identified. The endoaortic occlusion balloon of the ESTECH RAPTM system was filled and cardioplegia was introduced. The LIMA was sutured to the LAD using 7/0 PronovaTM (Ethicon). The endoaortic occlusion balloon was released and the heart was reperfused. After rewarming, the patient was weaned from cardiopulmonary bypass without difficulty. After decannulation, protamin was given and the thoracic cavity was inspected for hemostasis. The robotic system was removed. A 7 F arterial access sheath was brought into the reconstructed femoral artery. Using a 6 F LIMA catheter, the left internal mammary artery was intubated and visualized by intraoperative angiogra-

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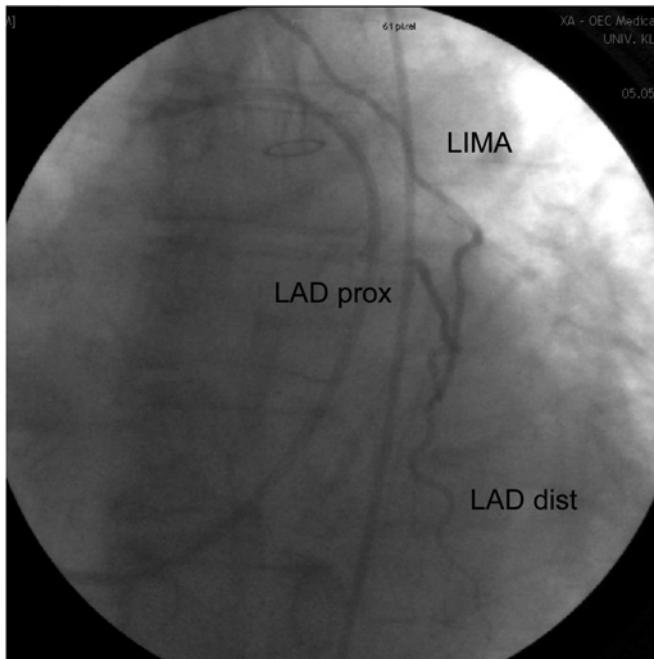


Figure 1. Patent LIMA to LAD graft on intraoperative angiography. LIMA indicates left internal mammary artery; LAD prox, proximal left anterior descending artery; and LAD dist, distal left anterior descending artery.

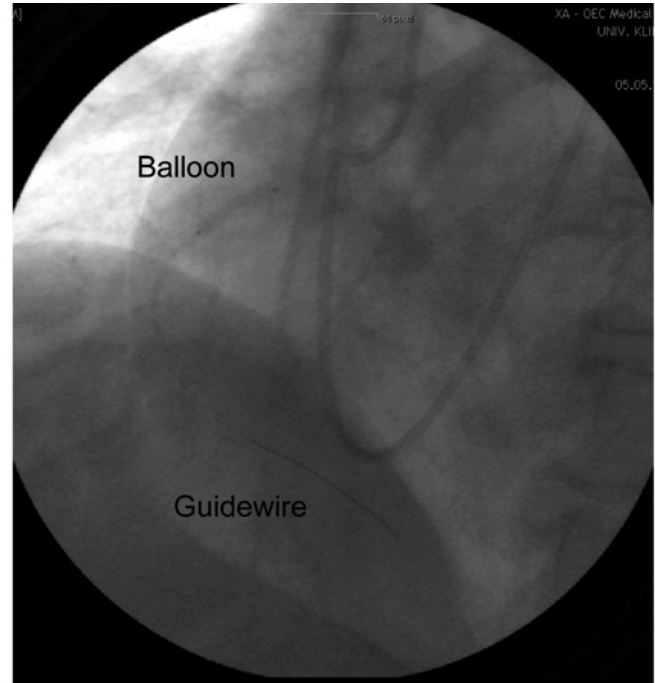


Figure 2. PTCA balloon inflation during placement of the drug-eluting stents immediately after TECAB. The catheter-based intervention was performed in the operating room immediately after surgery through an access sheath in the reconstructed femoral artery.

phy (Figure 1, Video 1). For this examination, a mobile C-arm (GE OEC 9800) was used (Video 2). The course of the LIMA was without pathology and the LIMA to LAD anastomosis was patent. There was excellent run-off TIMI III into the proximal and distal target vessel. Thereafter, a guiding catheter was brought into the ostium of the right coronary artery. A guide wire was advanced and the lesions on the right coronary artery were predilated (Figure 2). A 13 mm/2.75 mm rapamycin-coated Cypher SelectTM (Cordis) stent was placed into the distal lesion and an 18 mm/2.75 mm Cypher SelectTM stent was placed into the proximal lesion (Video 3). The stenting result was very satisfactory (Video 4). The right coronary artery developed intermittent spasm, which could be managed by intraluminal application of nitroglycerine. The patient was transported to the intensive care unit without any signs of myocardial ischemia.

Postoperative Course

The patient had received aspirin 100 mg p.o. preoperatively and received 300 mg of clopidogrel 4 hours postoperatively. There was minimal bleeding and there were no signs of post-interventional myocardial ischemia. The patient was extubated 8 hours postoperatively. He stayed in the ICU for 18 hours and left the hospital on the 6th postoperative day. At 6 months follow-up examination, the patient was completely free of angina and had resumed full activity. Repeat coronary and graft angiography demonstrated a patent LIMA to LAD graft with TIMI III perfusion of the proximal and distal target vessel. There were no signs of in-stent restenosis in the right coronary artery.

DISCUSSION

With the advent of the minimally invasive direct coronary artery bypass grafting (MIDCAB) operation in the mid-1990s, hybrid coronary artery revascularization procedures were discussed for the first time and correspondingly carried out [Angelini 1996, Friedrich 1997]. Only a few larger series were published thereafter and hybrid coronary artery revascularization was never performed on a broad basis [Riess 1998, Wittwer 1999]. MIDCAB was abandoned by some groups because of technical difficulties. Problems with logistics of staged hybrid procedures prevented wider acceptance of the concept. The necessity of simultaneous interventions was always stated but simultaneous procedures were only very rarely reported. Angelini in his very early series demonstrated that the MIDCAB operation can be successfully carried out in the cardiac catheterization lab [Angelini 1996]. Cath lab operating rooms, the ideal prerequisite for simultaneous performance of surgery and PTCA/stenting, are still unavailable at most heart centers.

Recently, combined coronary interventions are regaining interest because of advances in both endoscopic coronary surgery and catheter-based intervention technology. Our case demonstrates that the surgical part of the hybrid procedure, robotic totally endoscopic coronary artery bypass (TECAB) has reached an acceptable routine stage and that this operation can be combined with drug-eluting stent placement in a conventional operating room if a mobile coronary angiographic imaging system is available. To our knowledge, no such hybrid intervention has been carried out so far on an elective basis. We have previously reported an emergency

case which was managed similarly [Bonatti 2005] and a prospective protocol was started thereafter.

Only minor problems were encountered during our current case. Despite the fact that robotic endoscopic coronary surgery on-pump using remote access perfusion and aortic endo-occlusion has received criticism, we apply this concept as it offers advantages such as a safety net, gain of space in the pleural cavity, and technically comfortable anastomotic suturing. Use of cardiopulmonary bypass was without any negative clinical sequelae for the patient in the current case. The femoral artery which was used for arterial CPB line access was also taken for angiographic access after decannulation and reconstruction. Imaging with the mobile coronary angiography system was adequate for proper PTCA and drug-eluting stent delivery. Successful use of the first generation of these C-arms in intraoperative angiography has been reported by other groups [Goldstein 1998, Mack 1999]. One surprising finding in our case was the occurrence of coronary artery spasm in the stenting target vessel. This functional narrowing was managed by injection of intraluminal nitroglycerine. Implantation of drug-eluting stents in hybrid procedures because of the potential problem of subacute stent thrombosis demands an aggressive anti-platelet regimen. Our patient was loaded with aspirine preoperatively and received clopidogrel in the immediate postoperative period. Despite this fact, postoperative bleeding was minimal. Further cases are of course necessary to demonstrate that TECAB can be performed with acceptable bleeding rates under full platelet inhibition.

We conclude that robotic TECAB and placement of drug-eluting stents can be performed as a simultaneous procedure in an operating room equipped with a mobile coronary angiography system.

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