

Totally Endoscopic Coronary Artery Bypass Grafting is Feasible in Morbidly Obese Patients

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ABSTRACT

Development of robotic technology has enabled totally endoscopic coronary artery bypass grafting (TECAB) procedures. With complete preservation of sternal and thoracic stability, this operation would be an interesting option for obese patients, who are known to be at higher risk for deep sternal wound infection. We describe a case of successful totally endoscopic left internal mammary artery to left anterior descending artery bypass grafting using the da Vinci tele-manipulation system in a patient who was morbidly obese. The patient underwent a so called staged hybrid coronary intervention with percutaneous angioplasty and placement of a stent to the right coronary artery.

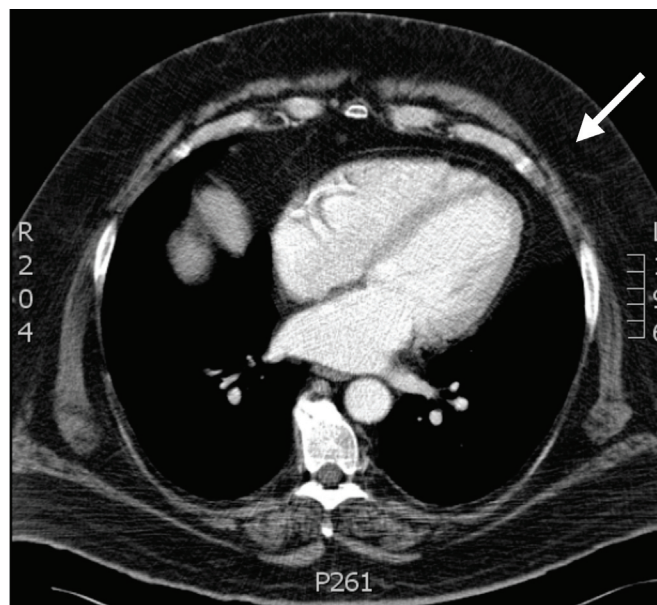
BACKGROUND

Coronary artery surgery is the most common adult open heart procedure performed worldwide. The advent of the Da Vinci Robotic "S" system (Intuitive Surgical, South El Monte, CA, USA) has made the totally endoscopic coronary artery bypass graft (TECAB) a feasible option for bypass surgery. There are still limitations, however, and one of them was considered to be morbid obesity. To our knowledge no paper is currently available reporting on endoscopic coronary surgery in this patient group. We present a case of a morbidly obese patient who underwent a left anterior artery (LIMA) to left anterior descending artery graft (LAD) through TECAB.

BRIEF HISTORY

A 66-year-old male patient with a history significant for morbid obesity (weight 320 lbs, 146 kg), hypertension, hypothyroidism (post-thyroidectomy), sleep apnea (home continuous positive airway pressure [CPAP] machine), and

diabetes had a positive stress test. He was referred for a coronary angiography, which revealed severe 3-vessel coronary artery disease. The left main coronary artery had 50% stenosis at its origin, a 95% proximal LAD lesion, a non-flow-limiting 30% lesion of the circumflex artery, and 70% proximal and 90% mid right coronary artery (RCA) lesions. The left ventricular function was normal. The patient was further referred to us for a possible TECAB of LAD and percutaneous intervention of RCA as a staged hybrid procedure. The risks and benefits were discussed with the patient and it was decided to proceed with TECAB of LIMA to LAD using the Da Vinci Robotic System as the first step of a hybrid coronary intervention. Preoperatively the patient underwent a thoracic and abdominal computed tomography (CT) angiography in order to evaluate the suitability for femorofemoral cardiopulmonary bypass and aortic endoocclusion. The figure shows the significant layer of subcutaneous fat that covered the bony thorax.



Computed tomography (CT) scan of the patient's chest. A significant layer of fat, which covered the bony thorax (arrow), would have made minithoracotomy access technically very difficult.

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PROCEDURE

General anesthesia was induced successfully using a double lumen endotracheal tube. The patient was positioned with the left side elevated at 30 degrees. The camera port was inserted in the anterior axillary line through the fifth intercostal space, and the other 2 working ports were inserted in the midclavicular line through the third and the seventh intercostal spaces. On inspection of the pleural cavity, the intrathoracic space was narrow, attributed to the morbid obesity. The left internal mammary artery was harvested endoscopically.

Simultaneously, left femoral vessels were exposed for peripheral bypass cannulation. A dual stage venous cannula (QuickDraw, Cardioventions, Edwards Lifesciences, Irvine, CA, USA) was inserted and positioned with the tip in the superior vena cava (SVC) using transesophageal echocardiography (TEE) guidance. Similarly a 23-French arterial perfusion cannula (Cardioventions, Edwards Lifesciences, Irvine, CA) was inserted using TEE guidance. This was followed by advancement of the endoaortic occlusion balloon. It required multiple attempts to correctly position the balloon, since the guidewire was going into the left subclavian artery. The correct positioning of the endoaortic balloon in the proximal ascending aorta was successfully achieved with TEE guidance. Cardiopulmonary bypass (CPB) was instituted, and the patient's core temperature was cooled to 34 degrees. A 5-French distal femoral limb perfusion cannula was inserted as well.

The removal of the pericardial fat pad, although cumbersome in this patient, was successfully accomplished, and the anterior pericardial wall was exposed. Part of this maneuver was only feasible with the heart completely unloaded and both lungs deflated on heart lung machine. Once on full CPB, the endoaortic occlusion balloon was inflated, and cardiac arrest was obtained using adenosine followed by antegrade cardioplegia infusion through the occlusion balloon system. The pericardium was opened and the LAD identified. The vessel was exposed, and an arteriotomy was performed with cardioplegia running. This was followed by an end to side LIMA to LAD anastomosis using 7-0 Prolene. The LAD inflow and outflow were probed before the completion of the anastomosis. The endoaortic occlusion balloon was deflated, and sinus rhythm regained spontaneously. The patient was weaned off from CPB, and the femoral vessels were decannulated and repaired using 5-0 Prolene. Protamine was administered to reverse the heparin. Once adequate hemostasis was confirmed, the robotic arms were removed, a chest tube was inserted through caudal port site, and the others were closed in layers. Intraoperative LIMA graft angiography was performed by a cardiologist in cooperation with the heart surgeon. The initial images demonstrated a slow runoff due to coronary spasm. Intraluminal nitroglycerin, however, was able to release the spasm with good outflow. A second angiogram obtained through the left main artery demonstrated retrograde flow from the LAD into the LIMA, confirming the patency of the anastomosis as well. The catheter sheath was removed, and the groin closed in layers. The patient tolerated the procedure well and was transferred to the ICU in stable condition.

POSTOPERATIVE COURSE

The patient was extubated, placed on CPAP machine (at night for sleep apnea), and transferred to the step down unit on postoperative day (POD) 1. His chest tube was discontinued on POD 2. He underwent an RCA stent by Interventional Cardiology on POD 5 (Liberté® 2.5 × 4.5 mm, Boston Scientific, Natick, MA, USA). He was discharged home on POD 6 in stable condition. On a clinic visit 4 weeks postoperatively, the patient reported that he had resumed all major everyday activities.

DISCUSSION

TECAB is an evolving operation. The feasibility of the operation depends on the robotic instrumentation, surgeon's operative skill, and the patient's body habitus. To our knowledge, this is the first reported case of TECAB in a morbidly obese patient. It demonstrates that the patient's body mass in itself is not a contraindication for a TECAB. In addition, patients with multivessel coronary artery disease may be considered for a hybrid procedure, where the LIMA to LAD is performed through TECAB and the other vessels are treated by percutaneous coronary interventions.

Obesity has been identified as a major factor in sternal wound infections after conventional open heart surgery [Birkmeyer 1998; Kuduvalli 2002; Yap 2007]. Thus complete preservation of sternal stability is one of the main advantages in an endoscopic approach. Similar outcomes have been observed in abdominal procedures. Laparoscopic cholecystectomy, an endoscopic procedure, appeared to be the procedure of choice for obese patients in 2 recent publications [Sperlongano 2002; Sidhu 2007]. A comparison of open and laparoscopic nephrectomies in obese patients revealed that the laparoscopic technique, although more challenging at times, had superior outcomes in the perioperative period [Feder 2008].

An alternative to TECAB in this patient would have been the minimally invasive direct coronary artery bypass (MIDCAB), an operation where the LIMA is sutured to the LAD on the beating heart through minithoracotomy. Obese patients were found to be the most difficult candidates for this procedure, and thus a full sternotomy approach was recommended [Diegler 1999]. In our own experience, we also found that MIDCAB can be technically extremely challenging in this group. The keyhole view in MIDCAB does not allow full overview on the anatomy inside the chest. In addition, the mammary harvest by the conventional MIDCAB technique in obese patients is difficult and can lead to extensive soft tissue trauma. TECAB by full immersion of the operator's view into the chest offers significant advantages. All interesting parts of the thoracic cavity can be directly visualized in the 3D vision of the da Vinci robot.

The fact that the presented patient was operated on using remote access heart lung machine perfusion and cardioplegic arrest offered several additional advantages. Due to significant accumulations of fat inside the chest, the workspace was too narrow and parts of the LAD exposure maneuvers were carried out on pump with the heart unloaded. This was the only

way to complete this part of the procedure. A disadvantage of the on pump approach was prolongation of the operative time due to the fact that the guidewire for the balloon catheter spontaneously went into the subclavian artery. Several redirection maneuvers were necessary to finally position the guidewire into the ascending aorta. This problem, which can be solved in the majority of cases, has been described previously [Schachner 2005]. In the future, readily available fluoroscopy in a hybrid operating room can facilitate redirection of catheters expeditiously.

We conclude that totally endoscopic placement of a LIMA bypass graft to the LAD is feasible in patients with morbid obesity. The utilization of the heart lung machine may facilitate the operation by gain of space. Staged hybrid coronary interventions are also feasible in morbidly obese patients. Return to all everyday activities within 4 weeks postoperatively is realistic in this difficult patient group.

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