A new exposure technique for the circumflex coronary artery system in robotic totally endoscopic coronary artery bypass grafting

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Abstract

We report a case of a 53-year-old female patient with isolated left main coronary artery stenosis in whom a completely endoscopic double coronary artery bypass grafting (CABG) procedure was performed. The operation was carried out on the arrested heart. A right internal mammary artery graft was sutured to the left anterior descending artery using the daVinci™ telemanipulation system. The left internal mammary artery was connected to the first obtuse marginal branch which was exposed with the Octopus-TE™ stabilizing device. This method may be useful for further development of multivessel totally endoscopic CABG procedures.

Keywords: Coronary artery bypass grafting; Endoscopic surgery; Robotic surgery; Left main coronary artery stenosis

1. Introduction

Since the performance of the first totally endoscopic coronary artery bypass grafting procedure [1], endoscopic coronary surgery has been mainly restricted to single vessel procedures and only a few cases of double or triple bypass operations have been reported [2,3]. Endoscopic revascularization of the circumflex coronary artery system using robotic technology has so far been difficult because of exposure problems. We describe a case in which a patient with isolated left main stenosis, in addition to totally endoscopic right internal mammary artery (RIMA) graft to the left anterior descending artery (LAD), received a left internal mammary artery (LIMA) graft to the circumflex artery system. An exposure technique was used that has not been described previously.

2. Case report

A 53-year-old female patient presented to our unit with angina CCSC classification III. Her risk factors were hypertension and hypercholesterolemia. Moderate COPD was present. Echocardiography showed no regional wall motion abnormalities and a left ventricular ejection fraction of 70%. Coronary angiography revealed an isolated stenosis of the left main coronary artery close to the bifurcation.

2.1. Surgical technique

The patient was positioned in a 30° right lateral decubitus position. She had received a double lumen tube for single lung ventilation and two radial artery pressure lines for monitoring of the remote access perfusion system. The daVinci™ telemanipulation system (Intuitive Surgical, Sunnyvale, CA) was positioned, a cameraport was inserted into the 5th intercostal space in the anterior axillary line and working ports were placed in the 3rd and 7th intercostal spaces in the midclavicular line. Using CO₂ insufflation the pericardial fat pad was first removed because the working space was relatively narrow. The retrosternal tissue was divided and the right pleural space was entered for endoscopic harvesting of the right internal mammary artery. Thereafter the left internal mammary artery was harvested in endoscopic fashion. In parallel to harvesting of both internal mammary arteries, the left femoral artery and vein were exposed in the groin. A 27F venous drainage cannula was brought transfemorally into the right atrium and a 21F ESTECH RAP™ cannula (ESTECH, Danville, CA) was directed into the ascending aorta. Both cannulae were guided under TEE vision.

The pericardium was opened in an L-shaped fasion so as to expose the anterior and anterolateral wall of the left ventricle. The first obtuse marginal (OM) branch could be visualized by lifting the beating heart. Thereafter both internal mammary arteries were occluded by endoscopic bulldog-clamps and free flow was checked. In parallel to these steps, a subxiphoidal port was introduced into the left pleural space and the Octopus TE™ was inserted into the port under thoracoscopic vision.

Cardiopulmonary bypass was started and cardioplegia was infused into the aortic root after inflation of the endoaortic occlusion balloon. The Octopus TE™ (Medtronic, Minneapolis, MN) was advanced towards the first obtuse marginal branch, suction was applied and the arrested heart was lifted and rotated anteriorly (Fig. 1 and Video 1).
The vessel was incised under running cardioplegia. Retrograde flow from the target vessel mandated placement of two endoscopic silastic tapes. Following this maneuver adequate exposure of the target vessel was present and the left internal mammary artery was sutured to the OM I branch using 7/0-Pronova in a running fashion (Video 1). The vacuum suction and traction by the Octopus TE™ were released and the heart was rotated into its original position. The Octopus TE™ was removed from the thoracic cavity and the RIMA to LAD anastomosis was carried out using 7/0-Pronova.

The endoaortic occlusion balloon was released as well as the endoscopic bulldog-clamps on both internal mammary arteries. The heart regained sinus rhythm. After reperfusion and rewarming, the patient was weaned from cardiopulmonary bypass without problems and decannulated. Cardiopulmonary bypass time and endoaortic occlusion time were 183 min, and 131 min, respectively. Intraoperative angiography showed both grafts and anastomoses patent. A chest tube was placed into the left pleural space and the port holes, as well as the incision in the groin, were closed. Total operative time was 9 h.

2.2. Postoperative course

Chest tube drainage during the first 12 postoperative hours was 200 ml. There were no signs of perioperative myocardial ischemia. The patient was extubated 34 h postoperatively and discharged from the hospital on the 10th postoperative day.

3. Discussion

Only a few cases of closed chest multivessel CABG have been reported worldwide. The Frankfurt robotic heart surgery team has described cases of double internal mammary artery grafting to the left anterior descending artery and to the right coronary artery. Frankfurt and Dresden reported a case of RIMA to LAD and LIMA to OM grafting [2,3]. Methods of OM exposure are not mentioned in these papers. Endoscopic revascularization procedures of the lateral and backwall of the heart have so far been regarded as very difficult due to visualization problems of these areas of the heart. Endoscopic retracting devices have not been developed for this specific purpose. The EndoStarfish™ (Medtronic, Minneapolis, MN) may be one option, but is primarily designed for minithoracotomy approaches and, in our opinion, is too bulky for a completely endoscopic operation.

The Octopus TE™ device has been primarily designed for endoscopic coronary surgery on the beating heart. We did not perform the operation described in this case report off pump because space in the left thorax as well as presence of left main disease were a concern. Our case demonstrates that the Octopus TE™ may be elegantly used in endoscopic multivessel coronary artery bypass grafting on the arrested heart. Performing these procedures under cardioplegia offers the advantage that the heart is completely unloaded and that both lungs can be disconnected from the ventilation. This significantly increases space inside the thorax and the heart can be rotated and moved more easily.

Using the Octopus TE™ as a suction and rotation device, the first obtuse marginal branch was adequately exposed in our case and anastomotic suturing was performed without major difficulties. Long cardiopulmonary bypass time in conjunction with the presence of COPD can explain moderately prolonged postoperative ventilation time. The patient had signed a special informed consent about this fact preoperatively.

Successful completely endoscopic surgical treatment of isolated left main stenoses, using both internal mammary arteries, may broaden the indications for endoscopic coronary surgery. In our case the endoscopic approach was of advantage because, given the patients weight and body shape, a significant risk for postoperative sternal dehiscence was present. As the patient was actively working, regain of every day activities and work – already at 3 weeks postoperatively – was of major importance and compensated for the investment of longer OR time and ventilation time.

We conclude that completely endoscopic bilateral internal mammary artery grafting to the LAD and the OM in cases of left main stenosis is feasible using the Octopus TE™ as a retraction- and exposure device.

References

