CLOSED-CHEST CORONARY ARTERY SURGERY ON THE BEATING HEART WITH THE USE OF A ROBOTIC SYSTEM

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The introduction of robotic instrumentation has led to new minimally invasive surgical options in patients with coronary artery disease.¹⁻⁴ The application of an intrathoracic stabilizer enables closed-chest off-pump coronary artery bypass grafting (CABG) via a 4-point stab incision, avoiding sternotomy and minithoracotomy. We present a case of closed-chest off-pump CABG performed with wrist-enhanced robotic instrumentation in a patient with single-vessel coronary artery disease. The left internal thoracic artery (LITA) was used as the graft (operative day March 27, 2000).

Fig 1. Intraoperative photograph showing the wrist-enhanced da Vinci robotic system (Intuitive Surgical, Inc).

Fig 2. Manual retractor (Intuitive Surgical, Inc) used as a stabilizer for closed-chest off-pump CABG procedures.

Clinical summary. A 75-year-old man with recurrent angina pectoris underwent coronary angiography, which revealed a significant lesion of the left anterior descending coronary artery. The left ventricular ejection fraction was 56%. Physical examination indicated that the patient was in New York Heart Association class II and Canadian Cardiovascular Society stage II.

For the operation, the patient was placed in the supine position with the left arm resting slightly beneath the posterior axillary line. After induction of general anesthesia, a double-lumen tube was used for single-lung ventilation during the operation. Three 1-cm skin incisions were placed in the left side of the chest in the third intercostal space at the median clavicular line, in the fifth intercostal space at the anterior axillary line, and in the sixth intercostal space at the median clavicular line.

Through the optical port, carbon dioxide insufflation was started at a pressure of 8 to 10 mm Hg. The actuators and camera of the da Vinci Surgical System (Intuitive Surgical, Inc, Mountain View, Calif) were placed via three ports. After a brief exploration of the left chest cavity and identification of the LITA, LITA takedown was begun. A pedicle was cre-

Fig 3. Postoperative photograph of the patient at discharge from the hospital.

ated, and the LITA pedicle was skeletonized and spatulated for anastomosis. LITA takedown required 26 minutes (Fig 1).

A vessel clamp was introduced via the right port and placed on the artery about 3 cm proximal to the distal end, and the vessel was transected. Blood flow through the LITA was checked by temporary release of the vessel clamp. Proximal and distal vessel loops were placed along the site of anastomosis by means of the two robotic arms.

An additional 1-cm subxiphoid port was placed for a stabilizing device (Intuitive Surgical, Fig 2). After placement of the stabilizing device on the left anterior descending coronary artery, blood flow through this vessel was temporarily interrupted by means of the vessel loops. Graft anastomosis was completed with the da Vinci Surgical System with the use of a 7-0 Prolene running suture (Ethicon, Inc, Somerville, NJ). To preserve a bloodless operating field, we flushed the field with saline solution. The anastomosis was completed, the vessel clamp was released, and the anastomosis was explored for leakage.

During and after the operation, no signs of acute cardiac ischemia were observed and no inotropic support was necessary. Protamine was administered and the actuators and camera were removed. A chest tube was inserted in the left pleural cavity via the incision in the sixth intercostal space on the median clavicular line. Before transfer of the patient to the intensive care unit, the double-lumen endotracheal tube was replaced with a single-lumen endotracheal tube.

Results. The whole procedure was performed with four 1-cm incisions by means of the da Vinci wrist-enhanced robotic system. The LITA was harvested in 26 minutes, the anastomosis was performed in 29 minutes, and the operation was completed in 130 minutes. The patient stayed in the intensive care unit for 17 hours. Postoperative blood loss was 250 mL.

Postoperatively, the patient was continuously in sinus rhythm, never showing signs of ischemia on the electrocardiogram or the need for inotropic support. Troponin T and creatine kinase MB/creatinine kinase fraction were always within normal limits, thus excluding the possibility of myocardial infarction. No perioperative complications occurred. A stress electrocardiogram on postoperative day 7 showed no evidence of myocardial ischemia. The patient was discharged from the hospital on postoperative day 7 in New York Heart Association class I and Canadian Cardiovascular Society stage I (Fig 3).

Discussion. A closed-chest off-pump CABG of single-vessel coronary artery disease was performed with the da Vinci Surgical System. This new minimally invasive technique is a promising alternative for patients with single-vessel coronary artery disease, avoiding median sternotomy and minithoracotomy. Since extracorporeal circulation was not used, that additional trauma was avoided. Seven days' hospitalization may seem prolonged for such a minimally invasive procedure, but it is standard for the German national medical care system.

In our opinion, the described case reflects a major step toward totally endoscopic surgical treatment of patients with complex coronary artery disease, especially for patients having serious risk factors for extracorporeal circulation and delayed wound healing.

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