



How to robotically take down a mammary artery

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Introduction

Robotic-assisted, minimally invasive direct coronary artery bypass (MIDCAB) describes a robotic-assisted thoracoscopic left internal mammary artery (LIMA) takedown with creation of a hand-sewn LIMA-left anterior descending artery (LAD) anastomosis via a non-rib-spreading left anterior mini-thoracotomy. When multivessel disease is present, if complete revascularization can be pursued, the European Society of Cardiology has affirmed a combined MIDCAB and percutaneous coronary intervention (PCI) as an alternative to traditional coronary artery bypass grafting (CABG) (1). MIDCAB is increasingly common, and we have demonstrated that surgeons can become proficient in as few as twenty cases (2,3). We present a case of a patient undergoing MIDCAB and describe our approach to LIMA takedown.

Clinical vignette

A 56-year-old male with a history of stenting to his right coronary system presented for cardiac catheterization following an abnormal stress test. He was found to have LAD and circumflex disease. After discussion with the heart team, the plan was hybrid revascularization in a staged fashion with MIDCAB performed during the current admission and PCI to the circumflex in 4–6 weeks.

Surgical technique

Surgical positioning/preparation

Standard invasive lines and monitors are placed, and selective right lung ventilation is performed via a double lumen endotracheal tube. The patient is positioned in a modified supine position with the left scapula bumped, and the left arm supported below the level of the operative table. Three ports are introduced into the left thoracic cavity in the second, fourth, and sixth interspaces and the thoracic cavity is insufflated with carbon dioxide. The da Vinci Xi Surgical Robot (Intuitive Surgical Inc., Sunnyvale, CA, USA) is docked. We do not ‘target’ the robot for deployment; however, all instruments are triangulated into the working field at the cranial origin of the mammary artery.

Robotic assisted mammary harvesting

The LIMA is harvested from its cranial attachment to the subclavian artery to its bifurcation with the use of robotic instruments only. The endothoracic fascia is opened lateral to the LIMA, which is mobilized in a skeletonized fashion working in a cranial to caudal direction. The fascial margin is completely opened prior to branch division, and the free edge is utilized for downward traction on the LIMA.

When necessary, the mammary artery can be handled at the adventitial level only; however, we avoid grabbing the mammary artery directly whenever possible. Smaller branches are divided with a single clip at the base of the branch and monopolar electrocautery at the chest wall, whereas larger branches are doubly clipped and divided either with monopolar energy or sharply with a robotic Potts scissor. The mammary vein is left on the chest wall untouched; however, if venous bleeding is encountered, this can be controlled with bipolar energy, frequently without the use of additional clips.

After complete mobilization to and visualization of the bifurcation, the patient is heparinized to an activated clotting time (ACT) greater than 300 seconds and the mammary artery is clipped in triplicate—two clips distally on the chest wall and one proximally—and then sharply divided. The pericardium is opened over the right ventricular outflow tract, extended cephalad to the pulmonary artery and distally to the apex, allowing confirmation of the target anatomy and diagonal branches. The mammary artery is clipped to the lateral pericardial defect to allow easy retrieval at time of thoracotomy. After removal of the working arms, insufflation is reduced to confirm anastomosis site alignment with planned anterior thoracotomy incision.

Direct coronary artery anastomosis

The fourth interspace port site is extended and a mini thoracotomy is performed. Utilization of a soft tissue retractor and pericardial stay sutures allows visualization of the LAD with minimal rib spreading. An off-pump LIMA-LAD anastomosis is performed with the assistance of an intracoronary shunt, carbon dioxide humidified blower and a cardiac stabilizing retractor. After the anastomosis is completed, protamine is administered and transit-time flow measurements confirm satisfactory graft patency.

Completion of operation

All wounds are closed in the standard fashion. A channel drain is placed through the second intercostal incision into the pericardial space and a chest tube through the sixth intercostal incision is left within the pleural space.

Postoperative course

Patients are started on dual antiplatelet therapy immediately

postoperatively. Chest tubes are removed on postoperative day one and the patient is discharged home on postoperative day three.

Comments

Clinical results

MIDCAB has been demonstrated at our center to have excellent outcomes. In patients with isolated LAD disease, we have demonstrated a greater than 90% survival rate at nine years for both MIDCAB and PCI; however, MIDCAB had a significantly reduced LAD reintervention rate (2.5% *vs.* 13.4%, $P < 0.0001$) (4). For patients requiring multivessel revascularization, we have experienced success with a hybrid approach with an eleven-year survival rate of 93.7% and fewer than 15% of patients requiring repeat revascularization.

Advantages and caveats

Although we have previously demonstrated that MIDCAB can be performed efficiently in under twenty operations, implementation remains limited. Therefore, we accept that our experience is at a high-volume center and may not be directly applicable to all cardiac centers; however, we believe MIDCAB offers an excellent approach to LAD revascularization as an isolated procedure or as part of a hybrid approach.

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Footnote

Conflicts of Interest: N.C.P. is on the scientific advisory board of Vascular Graft Solutions. The other authors have no conflicts of interest to declare.

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