Editorial

How to start a robotic coronary bypass grafting program: suggestions from an experienced robotic-assisted coronary surgeon

Amalia A. Jonsson, Michael E. Halkos

Division of Cardiothoracic Surgery, Emory University School of Medicine, Atlanta, GA, USA

Correspondence to: Dr. Michael E. Halkos, MD, MSc. Division of Cardiothoracic Surgery, Emory University School of Medicine, 5665 Peachtree Dunwoody Rd, Ste 200, Atlanta, GA, USA. Email: mhalkos@emory.edu.

Keywords: Program development; robotic cardiac surgery; coronary bypass

Submitted Nov 22, 2023. Accepted for publication May 07, 2024. Published online Sep 24, 2024.
doi: 10.21037/acs-2023-rcabg-10
View this article at: https://dx.doi.org/10.21037/acs-2023-rcabg-10

Robotic-assisted coronary artery bypass grafting (CABG) is a less-invasive option for patients with isolated left anterior descending (LAD) disease or selected, less-complex multi-vessel coronary disease providing the benefits of the left internal mammary artery (LIMA) to the LAD graft while avoiding the morbidity of a sternotomy. For patients with multivessel coronary artery disease (CAD), this technique can be combined with percutaneous coronary intervention (PCI) for a hybrid revascularization strategy (1). We have previously published our results from our first 1,000 consecutive robotic-assisted CABG cases demonstrating the learning curve for this technique with a threshold for mastery, defined as no further improvement in outcomes, at approximately 250 cases (2). However, even early in our experience safety and efficacy were demonstrated.

Our robotic-assisted CABG program evolved from other minimally-invasive techniques at Emory. In the 1990's, several Emory surgeons adopted minimally invasive direct coronary artery bypass. Adoption and subsequently, growth, was slow and limited by post-thoracotomy pain and the challenges associated with this approach, which included exposure for LIMA harvesting and expertise with off-pump coronary artery bypass (OPCAB). In the late 1990's, Emory surgeons developed expertise in OPCAB (3). In the early 2000's, endoscopic atraumatic coronary artery bypass (endoACAB) became the primary minimally-invasive CABG approach (4). With the first purchase of the da Vinci robotic system in 2008–2009, endoACAB was abandoned for robotic LIMA harvesting. Unlike shafted instruments and low fidelity visualization with the endoscopic LIMA harvest, robotic technology introduced magnified and high-definition visualization and instrumentation with multiple degrees of motion which simplified the LIMA harvest. The transition from a small minimally invasive CABG program to a destination reference center required collaboration from multiple disciplines. The initiation and subsequent growth of our program was largely driven by our Emory interventional cardiology colleagues, who appreciated the superiority of the LIMA-LAD graft but also recognized the shortcomings of vein grafting the non-LAD territories, especially for patients with less complex CAD. In our earlier experience, a majority of these patients presented with acute coronary syndromes (ACS) and were inpatients at the time of consultation. We continue to perform these procedures on this patient population, but the majority of recent growth has been in patients seen first in the ambulatory setting. These are patients with stable CAD or those that are referred from outside our healthcare system that presented with an ACS due to a non-LAD culprit lesion that was treated percutaneously. Our hospital administration and nursing leadership committed to dedicated robotic operating room teams until expertise was obtained prior to educating other staff members with this procedure.

Adopting any new procedure in cardiac surgery is often met with skepticism and quality concerns. One of the critical steps for the early success of our program, and to ensure quality with this approach, was our insistence to document LIMA-LAD patency after the procedure. This was either done with postoperative catheterization prior to discharge or when feasible, with completion angiography in a hybrid room. This was done routinely in the first 100–200 patients and is still done selectively in isolated LAD patients and routinely in all hybrid patients that have PCI after LIMA-LAD bypass. Today, CT angiography is widely available and acceptable and can be done postoperatively in the hospital or outpatient setting. Postoperative or completion angiography accomplished three goals for our program: (I) it ensured graft patency and quality; (II) it provided confirmation of the approach and instilled confidence with our referring cardiologists inside and outside the Emory system; (III) we learned a lot about our anastomotic techniques and were able to make subsequent modifications in our evolution to perfect anastomoses, from the length and tortuosity of our LIMA grafts to the heel and toe suture techniques to ensure a patulous anastomosis. The postoperative or completion angiograms, in our opinion, were the single quality control factor that led to the success of our program. The other critical factor was appropriate patient selection. In our early experience, we required that patients have an appropriate body habitus, adequate chest cavity size to facilitate robotic LIMA harvesting, hemodynamic stability without ongoing ischemia signs or symptoms, and a good LAD target for the anastomosis. Currently, we will offer this procedure if one of these criteria are not met but in general patients need to have either favorable body habitus or a good LAD target for anastomosis. We still routinely avoid this procedure for any patients that are unstable or with ongoing ischemia.

A multidisciplinary endeavor like this requires engagement and commitment from all members of the team. An example of this is our fast-track protocol lead by cardiac anesthesiology, where selected robotic CABG patients bypass the intensive care unit. This protocol was developed to identify certain patients that could be recovered in a postoperative anesthesia care unit and if specific criteria were met, these patients could then be transferred directly to the telemetry unit avoiding an intensive care unit stay altogether. This protocol in addition to decreasing hospital length of stay resulted in a 15% net reduction in inpatient costs. Importantly, there were no deaths or strokes reported in this analysis, and rates of adverse events were unchanged among the groups (5).

Capitalizing on the widely accepted advantages of LIMA-LAD grafting, robotic-assisted CABG procedures can be adopted by coronary surgeons, provide the benefits to patients with either isolated LAD disease or less complex multivessel disease that may have otherwise been treated with multivessel PCI, and lead to increase coronary surgical volumes for a cardiac program. The intent of this procedure is not to deny traditional sternotomy CABG for patients with complex CAD or even a multi-arterial grafting strategy for patients that may benefit from additional arterial grafts. Instead, the goal is to ensure that all patients with LAD disease get treated with the best option available, which in many, or even most cases, is the LIMA graft. Having this option available ensures that the best treatment will be provided to each individual patient in a collaborative approach with interventional cardiology.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: Both authors have no conflicts of interest to declare.

References

1. Halkos ME, Liberman HA, Devireddy C, et al. Early clinical and angiographic outcomes after robotic-assisted coronary artery bypass surgery. J Thorac Cardiovasc Surg 2014;147:179-85.
2. Jonsson A, Binongo J, Patel P, et al. Mastering the Learning Curve for Robotic-Assisted Coronary Artery Bypass Surgery. Ann Thorac Surg 2023;115:1118-25.
3. Puskas JD, Williams WH, Mahoney EM, et al. Off-pump vs conventional coronary artery bypass grafting: early and 1-year graft patency, cost, and quality-of-life outcomes: a

randomized trial. JAMA 2004;291:1841-9.
4. Vassiliades TA Jr, Reddy VS, Puskas JD, et al. Long-term results of the endoscopic atraumatic coronary artery bypass. Ann Thorac Surg 2007;83:979-85.
5. Edwards J, Binongo J, Mullin B, et al. Intensive Care Unit Bypass for Robotic-Assisted Single-Vessel Coronary Artery Bypass Grafting. Ann Thorac Surg 2023;115:511-7.

Cite this article as: Jonsson AA, Halkos ME. How to start a robotic coronary bypass grafting program: suggestions from an experienced robotic-assisted coronary surgeon. Ann Cardiothorac Surg 2024;13(5):436-438. doi: 10.21037/acs-2023-rcabg-10

