multivessel disease. Recent discussion largely focused on increased use of off-pump and complex, multiarterial grafting has some proposing a potential benefit and need for “coronary revascularization specialists.”^{7,8} So too, perhaps with MIDCAB, an admittedly undefined level of passion, experience, and technical proficiency is needed to maximize its potential.

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Commentary: Sternotomy for every cardiac surgery patient ain't the future, so let's get going

Marc Ruel, MD, MPH, FRCSC, FAHA, FCCS

In this issue of the *Journal*, Davierwala and colleagues¹ present their experience of 2667 patients who underwent minimally invasive direct coronary artery bypass grafts (MIDCABs) at the Leipzig Heart Center between 1996 and 2018, which amounted to 9% of coronary artery bypass graft (CABG) operations performed during that time. The number of MIDCABs decreased to about one-half the initial frequency during the last two-thirds of the study period,

Marc Ruel, MD, MPH, FRCSC, FAHA, FCCS

CENTRAL MESSAGE

Compelling surgical experiences such as the one reported here by Davierwala et al. have a key role in telling the world about nonsternotomy CABG and helping our community better embrace it.

possibly as a result of more multivessel sternotomy off-pump coronary artery bypass and minimally invasive (MICS) CABGs being performed.²

In the Leipzig cohort, mean age was 64.5 ± 10.9 years, and 74% of patients were male. Notably, 55% of patients had single-vessel coronary artery disease, implying that hybrid or incomplete coronary revascularization may have occurred in a sizable proportion of patients. Cardiopulmonary bypass was used in 2% of patients and conversion to sternotomy occurred in 1%. Perioperative mortality

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Dr Ruel is a minimally invasive coronary artery bypass graft proctor and Principal Investigator of the MIST (Minimally Invasive coronary surgery compared to Sternotomy coronary artery bypass grafting) trial (both with support from Medtronic, Inc).

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TABLE 1. MICS CABG: What is difficult and what is not

What is important yet not difficult
Starting by becoming a strong OPCAB surgeon
Getting training on nonsternotomy CABG
Selecting patients with a favorable CT ratio (<0.5) on CXR
Keeping the RV not too filled (CVP 10 mm Hg or less)
Harvesting the LITA
Using the radial artery as a second arterial graft
Using CPB assistance to decompress the heart
Positively identifying coronary vessels by correlating with the angiogram in the OR
What is more challenging
Patients with obesity
Patients with left ventricular hypertrophy or dilatation
Harvesting the RITA
Performing proximal or other inflow anastomoses (Y- or T-grafts)
Grafting the PDA or distal obtuse marginals
Making sure conduits are just the right length and not twisted (eg, skeletonized ITA)
Staying off-pump in every patient
Controlling early postoperative pain
Making MICS CABG a routine therapy for a high proportion of patients

OPCAB, Off-pump coronary artery bypass; CABG, coronary artery bypass graft; CT, cardiothoracic; CXR, chest radiograph; RV, right ventricle; CVP, central venous pressure; LITA, left internal thoracic artery; CPB, cardiopulmonary bypass; OR, operating room; RITA, right internal thoracic artery; PDA, patent ductus arteriosus; ITA, internal thoracic artery; MICS, minimally invasive.

was 0.9%. With follow-up on approximately 90% of patients, 10-year survival was estimated at $77.7 \pm 0.9\%$ and was adversely influenced by diabetes mellitus and left ventricular dysfunction. The authors did not evaluate pain outcomes, time to physical recovery, or functional status over the study period.

Although CABG is currently experiencing some resurgence over percutaneous coronary intervention for stable ischemic heart disease, physical recovery from sternotomy takes about 6 months and roughly one third of patients do not fully heal from it.³⁻⁵ The future of cardiac surgery warrants that we embrace ways to avoid sternotomy while preserving the robust role that the crafting of new arteries around the heart, particularly the durable left internal thoracic artery (LITA), brings to patients with severe coronary artery disease in regards to symptom relief and survival. As MIDCAB means different things to different surgeons, MICS CABG is a more appropriate term because it depicts both single-vessel (usually LITA—left anterior descending artery with full LITA harvest via a more lateral approach than the original MIDCAB⁶) or multivessel revascularization, which became an option because of the more lateral approach (Table 1).² MICS CABG can be accomplished through a “traditional” small anterolateral thoracotomy or with robotic assistance. By providing nonsternotomy CABG, any iteration of MICS CABG adds to the heart team’s therapeutic armamentarium, and advanced cardiac surgery centers should have at least one expert surgeon who can provide these less-invasive options.

The Minimally Invasive coronary surgery compared to STernotomy coronary artery bypass grafting (MIST) trial

is under way.⁷ Its results will be key in determining whether nonsternotomy CABG leads to better recovery because it is less invasive, and whether it can be performed as safely as conventional CABG. Compelling surgical experiences such as the one reported here by Davierwala and colleagues have a germane role in telling the world about nonsternotomy CABG as a viable option for surgical coronary revascularization. We can be quite certain that the future of CABG ain’t gonna involve cutting the sternum in 2 halves, stopping the heart, and putting ice on it—that operation is a dinosaur bound for extinction. By working together on safe and effective surgical innovation, being mindful of the patient’s recovery and quality of life indicators, we will successfully design the CABG operation of the future.

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Commentary: “Do or do not. There is no try”: Which role for minimally invasive direct coronary artery bypass?

Arnaldo Dimagli, MD, and
Umberto Benedetto, MD, PhD

Equipoise between coronary artery bypass grafting (CABG) and percutaneous coronary artery intervention (PCI) exists regarding the outcomes following revascularization of isolated left anterior descending (LAD) artery; as, such both strategies are recommended by the latest guidelines on myocardial revascularization.¹ PCI is usually preferred by the patients, and it is easy to understand why: it would be hard to opt for a full sternotomy, potential cardiopulmonary bypass-related complications, and tougher and longer recovery when an arterial puncture is the alternative choice on the shelf.

Innovations have radically changed the treatment of heart valve disease; still today most of CABG cases are performed with median sternotomy and on-pump.² Minimally invasive direct coronary artery bypass (MIDCAB) represents an attractive alternative to the conventional approach in patients with isolated LAD lesions with the advantage of avoiding full sternotomy and achieving a faster recovery. Although the safety of MIDCAB has been widely demonstrated, data on its long-term efficacy are still limited.

The series by Davierwala and colleagues³ reported on the outcomes of the more than 20-year experience of MIDCAB via left small anterior thoracotomy using the left internal

Arnaldo Dimagli, MD (left), and Umberto Benedetto, MD, PhD (right)

CENTRAL MESSAGE

Minimally invasive coronary artery bypass for isolated LAD disease can be safely performed and it is associated with excellent long-term outcomes when performed by experienced surgeons.

mammary artery to bypass the LAD. The number of MIDCABs performed in the authors' center remained stable over the time, with a median of 84 procedures/year, and in-hospital mortality did not change (overall 0.9%). More importantly, authors set an important clinical benchmark for long-term survival, with a survival rate of 66% and 55% at 15 years and 20 years, respectively.

This encouraging report must be interpreted considering that this is a single-center experience with robust familiarity with the surgical skills required for this technique. Indeed, the proficiency of this group had been previously shown in off-pump CABG with bilateral internal mammary arteries⁴ and in MIDCAB.⁵ In the current study, the authors demonstrate that they are well past their learning curve, which represents one of the difficulties when adopting a new, unfamiliar technique. As a consequence of this, the incidence of technical errors (ie, dissection of left internal mammary artery) and rate of conversion to sternotomy decreased over the years. This center also kept a constant caseload, and this is paramount to maintain MIDCAB skills and therefore assure good clinical outcomes. So, the results presented may not be generalizable to most surgeons and centers.

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