Nonetheless, we congratulate the authors on this timely analysis with extensive long-term follow-up. Overall, the outcomes were excellent with both approaches. Although current guidelines have a stronger recommendation for bypass surgery than PCI for isolated LAD disease, the findings of the ISCHEMIA (International Study of Comparative Health Effectiveness with Medical and Invasive Approaches) investigators suggest that an initial noninvasive approach is a reasonable strategy for many patients with stable ischemic heart disease.⁶ The decision to revascularize and the mode of revascularization for any individual patient should ideally be performed in a Heart Team setting, as was done in this study. Patel and colleagues illustrate that MIDCAB can be the procedure of choice, particularly for patients with nonfavorable lesion characteristics for PCI and if a patient has a long-anticipated life expectancy. As PCI options continue to evolve and improve, as surgeons, we must also strive to innovate, to provide state-of-the-art treatment options for our patients—this study by Patel and colleagues shows that MIDCAB for isolated LAD lesions is a welcomed innovation.

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Commentary: Is robotic-assisted coronary bypass ready for prime time?

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Minimally invasive direct coronary artery bypass (MID-CAB) has been plagued by challenges since its inception over 25 years ago. These center around its highly technical

Robot-assisted redo coronary bypass for LAD in-stent restenosis.

CENTRAL MESSAGE

Robot-assisted coronary bypass may have survival benefits over drug-eluting stents in older and obese patients with isolated, complex LAD stenosis.

nature: It can be challenging to harvest the entire internal thoracic artery and identify the left anterior descending (LAD) coronary artery via a minithoracotomy, and anatomic factors such as obesity, reoperation, and intramyocardial

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FIGURE 1. Robotic-assisted coronary bypass in an elderly, obese reoperative patient with LAD in-stent restenosis. LAD, Left anterior descending.

LAD increase difficulty. We have found that robotic assistance (Figure 1), as described by Patel and colleagues¹ in this issue of the *Journal*, largely addresses these challenges, shifting the question from feasibility to outcomes, and whether this approach compares favorably to coronary bypass via sternotomy or isolated percutaneous coronary intervention to the LAD. Since the landmark manuscripts by Calafiore and colleagues² (who harvested the internal thoracic artery for 4 cm through a 10-cm incision in 155 patients), and Subramanian and colleagues³ (who included 54 reoperative patients in their series of 185), several groups have demonstrated long-term good graft patency and clinical outcomes with MIDCAB.²⁻⁵ However, it remains unclear whether MIDCAB should be reserved for unstentable LAD lesions or whether this technically challenging approach has a role in the primary treatment of isolated LAD disease.

In the current issue of the *Journal*, Patel and colleagues¹ tackle this question by comparing long-term outcomes of isolated complex LAD disease revascularized by MIDCAB versus drug-eluting stents in 158 propensity-matched patient pairs.¹ This is a sophisticated attempt to address the selection bias arising from the tendency to limit surgery to unstentable isolated LAD disease, and the authors show equivalent survival between MIDCAB and stents at 9 years. Taken in isolation, this finding seems to support drug-eluting stents for isolated LAD disease; however, the authors also report that stents were associated with higher reintervention rates, particularly in patients with smaller stents. Of note, advanced age and obesity were associated with worse late mortality in the coronary stent group. We can therefore speculate that older and obese patients with complex LAD lesions may be better served with MIDCAB than drug-eluting stents. Finally, Patel and colleagues¹ demonstrate

that although MIDCAB is more costly than percutaneous coronary intervention during the index hospital admission, the total long-term costs including reinterventions are lower with MIDCAB than with drug-eluting stents.

This study confirms our experience that in selected patients, robotic-assisted MIDCAB may offer important benefits over percutaneous coronary intervention as the primary therapy for complex lesions of the LAD, especially for patients in whom the likelihood of reintervention is high, such as those with smaller stents and for elderly or obese patients. Is MIDCAB ready for prime time? The National Institutes of Health-funded multicenter Hybrid Coronary Revascularization Trial highlights the challenges of conducting randomized trials in this area, and without a more robust evidence-base the jury will remain out. Consequently, a collaborative effort among all stakeholders serving this patient population is essential to evaluate MIDCAB as a treatment strategy for primary isolated complex LAD disease. Patel and colleagues¹ deserve congratulations for their thoughtful approach, which confirms that a substantive heart team discussion is needed in patients with isolated complex LAD disease to determine the optimal treatment strategy because patient selection may be the most critical, modifiable risk factor to prevent late mortality and need for reintervention.

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Commentary: Minimally invasive coronary bypass or percutaneous coronary intervention for complex left anterior descending artery stenosis: A never-ending battle

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CENTRAL MESSAGE

Revascularization of complex LAD disease with minimally invasive direct coronary artery bypass provides excellent mid-term survival, with a low incidence of repeat vessel revascularization.

Percutaneous coronary intervention (PCI) and minimally invasive direct coronary artery bypass grafting (MIDCAB) are both well-established revascularization strategies (Class of Recommendation: I; Level of Evidence: A) for single-vessel disease of the left anterior descending artery (LAD).¹ Beyond the patient's preference, the choice of the optimal revascularization strategy by the Heart Team should be based on various other factors, including the patient's individual risk profile, coronary anatomy, institutional experience with both procedures, and, ultimately, long-term prognosis.¹ Consequently, the 2018 Joint Guidelines on Myocardial Revascularization of the European Society of Cardiology and European Association for Cardio-Thoracic Surgery advocate the formation of a "Coronary Heart Team" for patients with suitable coronary anatomy for both procedures (Class of Recommendation: I; Level of Evidence: C).¹

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Observational and randomized-controlled trials comparing early- and mid-term clinical results of MIDCAB versus PCI with drug-eluting stents (DES) for isolated proximal LAD disease uniformly suggest comparable clinical outcomes in terms of mortality, stroke, or myocardial infarction.²⁻⁴ Hannan and colleagues² reported in 715 propensity score-matched patients undergoing CABG/PCI-DES pairs a comparable 3-year mortality (5.5% vs 4.8%) and major adverse cardiocerebral event rate (7.8% vs 6.4%), respectively. Periprocedural and 12-month mortality was zero for both groups, whereas 7-year mortality did not differ between MIDCAB or sirolimus-eluting stent in isolated LAD disease (17% vs 14%) in a well-controlled, small-sized randomized-controlled trials.^{3,4} Importantly, both aforementioned trials demonstrate a greater risk for repeat revascularization with DES-PCI, thereby suggesting a long-term superiority of a single left internal thoracic artery graft to the LAD. Indeed, target vessel