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Editorial

# Is Robotic-Assisted Bypass Grafting Really Better Than PCI When It Comes to LAD CTO?

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Chronic total occlusions (CTO) are observed in about 20% of patients with significant coronary artery disease[1]; however, percutaneous coronary intervention (PCI) of CTO is not often pursued owing to a myriad of reasons, including poor success of recanalization, high likelihood of complications, longer time commitment to cases with increased amounts of radiation, and unclear clinical benefit, especially survival.[2] Regardless, there is a common agreed-upon indication for CTO PCI of angina relief, which results in improved physical function and quality of life,[3] supported by data.

In the EuroCTO trial, 396 patients with at least 1 CTO were randomized to recanalization plus optimal medical therapy vs optimal medical therapy alone after PCI of nonocclusive vessels.[4] At 12 months, those who underwent PCI improved more in the Seattle Angina Questionnaire for angina frequency and quality of life. The OPEN-CTO registry enrolled 1000 consecutive CTO PCIs performed and followed up these patients with systematic telephone follow-up by staff trained in health status interviews.[5] At just 1 month, patients showed improvement in quality-of-life scores and mean Rose Dyspnea Scale scores. These studies did not discriminate between affected vessels. One could hypothesize that patients may benefit most from CTO PCI of the left anterior descending artery (LAD), given the large myocardial territory it supplies. A retrospective analysis of 237 patients who underwent LAD CTO PCI found that these patients had an overall survival of 92% and 85% major adverse cardiovascular event (MACE)-free survival at 2 years.[6] Furthermore, patients with ischemic cardiomyopathy significantly improved their ejection fraction by 10.9% at 9 months.

Surgical revascularization is commonly used to treat LAD CTOs. Fefer et al[7] found that among 405 patients, CTOs were common, with most being bypassed, including all LAD CTOs. Superb long-term patency of left internal memory artery (LIMA) to the LAD may favor surgical revascularization, but perhaps with higher periprocedural morbidity than PCI. Robotically assisted coronary artery bypass graft has become more common and may offer an equivalent but less-invasive approach. A meta-analysis of 16 studies comprising 2290 patients showed that when compared with traditional coronary artery bypass grafting (CABG), totally endoscopic coronary artery bypass graft (TECAB) had lower rates of MACE 12 months postoperatively (7% vs 12.4%; $P < .05$).[8] Within those who had undergone robotic CABG, a more recent systematic review of 2947 patients showed a 30-day mortality of 0.3% for non-TECAB and 0.9% for TECAB with a late (40-month) mortality of 3.2% vs 2.4%, respectively.[9] There is, however, a paucity of data comparing LAD CTO PCI with robotic CABG.

In this issue of *JSCAI*, Hebbo et al[10] studied 273 patients with a LAD CTO who underwent either PCI or robotic-assisted single-vessel CABG in a retrospective cohort study. Procedural success was >94% in each group. Around 40% of patients in each arm underwent non-LAD PCI. Those who underwent CABG had greater postprocedural complications (35% vs 7%; $P < .001$) and greater length of hospital stay ($5.0 \pm 2.5$ days vs $1.5 \pm 3.5$ days; $P < .001$); however, over a median 3.4-year follow-up, those in the CABG group had significantly lower rates of MACE, myocardial infarction, and the need for repeat revascularization with no difference in mortality.

The authors acknowledge that the PCI group had a greater prevalence of comorbid conditions, which should be accounted for when considering the difference in the primary outcome. This included lower ejection fraction ($44\% \pm 14\%$ vs $52\% \pm 10\%$; $P < .001$), previous heart failure (36% vs 22%; $P = .02$), and diabetes mellitus (49% vs 24%; $P < .001$). Furthermore, no one in the CABG group had previous open surgeries, while 21 of the 129 in the PCI group had a previously bypassed LAD ($P < .001$). In addition, the PCI group appears to have more complex coronary anatomy with a Japanese-CTO score of ≥2 in >50% of the patients.

This article addresses a question that has not been well-studied. The findings suggest that robotic-assisted placement of a LIMA to an occluded LAD provides superior clinical outcomes that may be due to lower revascularization rates; however, this conclusion must be considered for potentially important biases that were not controlled for. The authors do not mention the patients' baseline or discharge medications. Appropriate guideline-directed medical therapy, as well as medication adherence, increases vessel patency. Additionally, it is uncertain how much image-guided PCI was used in this study. A substudy of RENOVATE-COMPLEX-PCI showed that intravascular imaging-

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guided PCI had a significantly lower risk of target vessel failure than angiography-guided PCI in patients with CTOs.[11] One may wonder whether CTO PCI of the LAD may have had even better outcomes if imaging was uniformly used.

While this study is in keeping with well-established data supporting the benefits of a LIMA, it raises some generalizability concerns. The patient population was composed of Caucasian males, making these data difficult to apply to females and those of different ethnicities who may have smaller caliber vessels. Furthermore, there is a concern for institutional and patient selection bias. The patients were not randomly matched but were chosen for one revascularization method vs another. Ideal patients for robotic-assisted CABG typically have a robust LAD with minimal distal disease. This may have biased patients with favorable LAD anatomy more toward surgery in this study. Finally, the expertise at medical centers (for robotic CABG and CTO PCI) varies, and the choice of treatment strategies and outcomes may differ at other facilities.

The authors provide important information to help us understand the management of LAD CTOs. Larger randomized studies controlling for biases with a more diverse patient population will broaden our understanding.

## Declaration of competing interest

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