

CTO vs Non-CTO Left Anterior Descending Artery Grafting During Robotic Totally Endoscopic Coronary Bypass: Is There a Difference in Outcomes?

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OBJECTIVE

CTO-LAD: A Complex Target for PCI

Chronic total occlusion (CTO) of the LAD is among the most technically challenging coronary lesions. PCI for CTO-LAD carries lower success rates and worse long-term outcomes vs. non-CTO disease.

Surgical Revascularization: CABG can ‘nullify’ the disadvantages of CTO anatomy as it treats the vessel beyond the occlusive disease and perfuses CABG bypasses the occlusion entirely and perfuses the distal vessel independent of lesion complexity.

Robotic TECAB: The Least Invasive Option

Robotic totally endoscopic coronary artery bypass (TECAB) delivers arterial grafting through small chest ports on a beating heart. We compare early and midterm outcomes after robotic TECAB to CTO-LAD vs non-CTO LAD.

PATIENTS & METHODS

Study Design: Single-center retrospective cohort

Study Period: July 2013 – December 2025

Analysis: 1:1 Propensity score matching → 83 well-matched pairs

Primary Endpoints: Midterm all-cause mortality & MACCE

All Robotic TECAB Patients (n = 1,008)

Single-Vessel LAD Grafting (LITA or RITA)
n = 409

CTO-LAD
n = 89

Non-CTO LAD
n = 320

Propensity-Matched Analysis = 83 Pairs

Statistics: Propensity score via logistic regression. Categorical variables by chi-square / Fisher's exact; continuous by Student's t-test. $p < 0.05$ = significant.

RESULTS

93%

Freedom from MACCE
(CTO group)

8.4%

Repeat revascularization
(CTO group, all PCI)

3.6%

Cardiac mortality
(CTO group)

100%

Midterm follow-up
completion

Table 1. Baseline & Selected Perioperative Characteristics

Variable	CTO-LAD (n = 83)	Non-CTO (n = 83)	p-value
DEMOGRAPHICS			
Left main disease, n (%)	3 (3.6)	13 (15.7)	0.008
Conduit — LITA, n (%)	80 (96.4)	80 (96.4)	1.000
Conduit — RITA, n (%)	3 (3.6)	3 (3.6)	1.000
INTRAOPERATIVE			
Target LAD diameter, mm (mean ± SD)	1.79 ± 0.35	2.00 ± 0.31	< 0.001
Anastomotic TTF, mL (mean ± SD)	102 ± 59	97 ± 54	0.562
Operative time, mins (mean ± SD)	171 ± 42	167 ± 53	0.706
EARLY POSTOPERATIVE (30 days)			
Atrial fibrillation, n (%)	9 (11)	4 (4.8)	0.151
MI, n (%)	0 (0)	0 (0)	-
Stroke, n (%)	0 (0)	1 (1.2)	0.320
Graft patency (select Pts)	12/12 (100)	15/17 (88)	0.882

Data presented as mean ± SD or n (%). NS = not significant. LITA = left internal thoracic artery; RITA = right internal thoracic artery; TTF = transit time flow.

Table 2. Midterm Clinical Outcomes

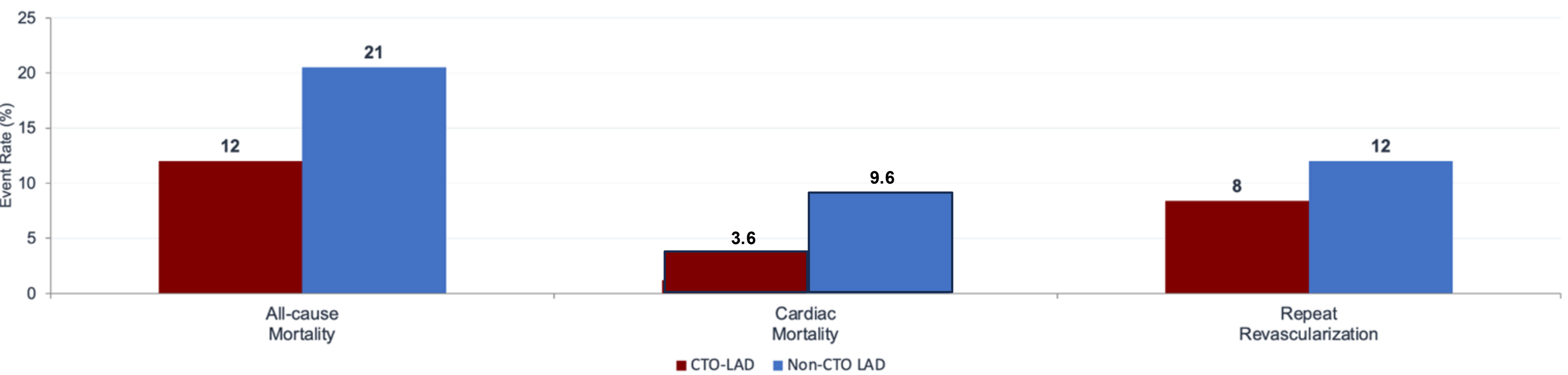
Outcome	CTO-LAD (n = 83)	Non-CTO (n = 83)
All-cause mortality, n (%)	10 (12)	17 (21)
Cardiac-related mortality, n (%)	3 (3.6)	8 (9.6)
Repeat revascularization †, n (%)	7 (8.4)	10 (12)
Freedom from MACCE, n (%)	77 (93)	76 (92)

† All repeat revascularizations were percutaneous (PCI). No patient in either group required redo cardiac surgery.

Midterm follow-up: 100% complete in both groups

- CTO: Mean of 49 ± 37 months
- Non-CTO: Mean of 45 ± 38 months

MIDTERM OUTCOMES — CTO vs Non-CTO LAD



All primary outcomes: No statistically significant differences between groups (all $p > 0.05$)

Factor	PCI for CTO-LAD	TECAB for CTO-LAD
Technical complexity	High	Low *
Success vs non-CTO	Reduced	Equivalent
Long-term outcomes	Worse vs non-CTO	Equivalent ✓
Bypasses occlusion	No	Yes ✓
Repeat revasc risk	Higher	Similar to non-CTO ✓

SURGICAL TECHNIQUE

da Vinci Si robotic platform

- Standard TECAB left-chest ports
- Skeletonized LITA/RITA harvest
- All anastomoses **off-pump, beating heart**
- Intraoperative TTF measurement
- Selective early angiography hybrid revascularization patients



Fig. 1 LITA harvest via da Vinci Si



Fig. 2 Sutured LITA-LAD anastomosis (CTO patient)

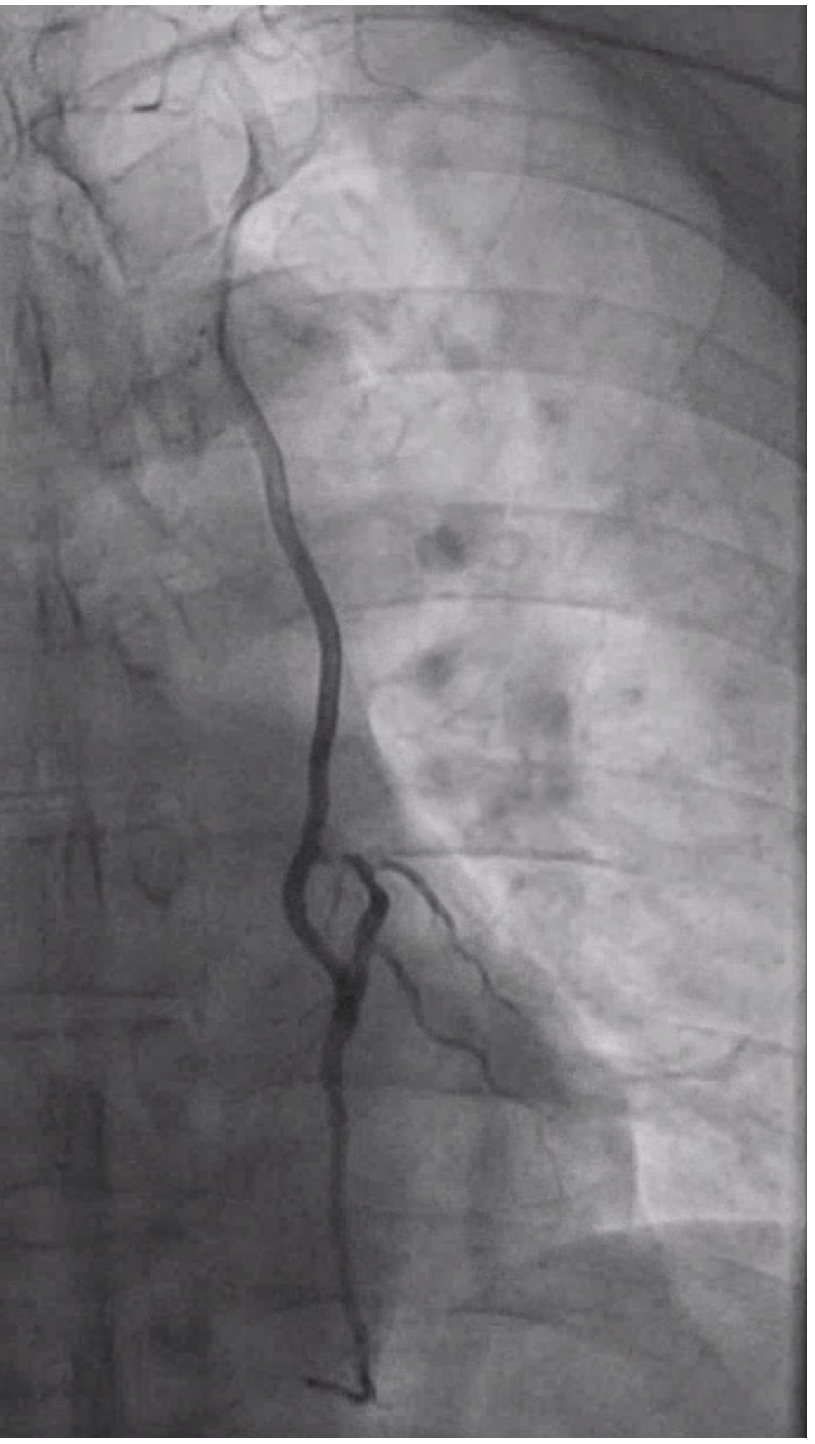


Fig. 3 Postoperative angiogram

LIMITATIONS

- Retrospective; single high-volume dedicated robotic program
- Modest sample size; powered for primary endpoints but not all subgroup analyses.
- Angiographic patency data limited to select patients

CONCLUSIONS

- In this propensity-matched study (83 pairs), robotic TECAB to CTO-LAD achieved equivalent early and midterm outcomes compared to non-CTO LAD.
- All-cause mortality, cardiac mortality, repeat revascularization, and MACCE rates were statistically similar at a mean follow-up exceeding 4 years (100% complete).
- CTO-LAD should not be considered a contraindication to robotic TECAB at experienced centers.

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DISCLOSURES: HH Balkhy is a proctor for Intuitive Surgical, manufacturer of the da Vinci robotic system. All other authors have no relevant disclosures.