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Outcomes of chronic total occlusion percutaneous coronary intervention in patients with prior coronary artery bypass graft surgery: Insights from the LATAM CTO registry

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Abstract

Objectives: To evaluate the outcomes of chronic total occlusion (CTO) percutaneous coronary intervention (PCI) in patients with and without prior coronary artery bypass graft (CABG) surgery.

[Correction added on December 27, 2021, after first online publication: Affiliation 16 was updated.]

Background: Data on the outcomes of CTO PCI in patients with versus without CABG remains limited and with scarce representation from developing regions like Latin America.

Methods: We evaluated patients undergoing CTO PCI in 42 centers participating in the LATAM CTO registry between 2008 and 2020. Statistical analyses were stratified according to CABG status. The outcomes of interest were technical and procedural success and in-hospital major adverse cardiac and cerebrovascular events (MACCE).

Results: A total of 1662 patients were included ($n = 1411$ [84.9%] no-CABG and $n = 251$ [15.1%] prior-CABG). Compared with no-CABG, those with prior-CABG were older (67 ± 11 vs. 64 ± 11 years; $p < 0.001$), had more comorbidities and lower left ventricular ejection fraction ($52.8 \pm 12.8\%$ vs. $54.4 \pm 11.7\%$; $p = 0.042$). Anatomic complexity was higher in the prior-CABG group (J-CTO score 2.46 ± 1.19 vs. 2.10 ± 1.22 ; $p < 0.001$; PROGRESS CTO score 1.28 ± 0.89 vs. 0.91 ± 0.85 ; $p < 0.001$). Absence of CABG was associated with lower risk of technical and procedural failure (OR: 0.60, 95% CI: 0.43–0.85 and OR: 0.58, 95% CI: 0.40–0.83, respectively). No significant differences in the incidence of in-hospital MACCE (3.8% no-CABG vs. 4.4% prior-CABG; $p = 0.766$) were observed between groups.

Conclusion: In a contemporary multicenter CTO-PCI registry from Latin America, prior-CABG patients had more comorbidities, higher anatomical complexity, lower success, and similar in-hospital adverse event rates compared with no-CABG patients.

KEYWORDS

chronic total occlusion, coronary artery bypass graft surgery, outcomes, percutaneous coronary intervention

1 | INTRODUCTION

Interest in chronic total occlusion (CTO) percutaneous coronary interventions (PCI) has recently grown worldwide in parallel with evolving techniques, dedicated equipment, adoption of validated algorithms, and assertiveness toward patient selection and appropriate indications for revascularization.^{1–4} New CTOs develop in up to 46% of patients after undergoing coronary artery bypass graft (CABG).^{3,5} Accelerated atherosclerotic disease progression in native coronary arteries proximal to the graft anastomosis has been described as a mechanism that explains the tendency of prior-CABG patients to develop CTOs.^{6,7} Severe calcification, proximal and distal cap ambiguity and the negative remodeling often associated with these lesions, as well as graft-induced vessel tenting and tortuosity make CTO-PCI in prior-CABG patients challenging. While CTO-PCI success rates in all-comers reach 85%–90%,^{8–10} patients with prior-CABG have higher failure rates and higher incidence of in-hospital complications compared with CABG-naïve subjects.³ Accordingly, a history of CABG is considered a risk factor for CTO crossing failure in specific prediction models.^{11,12}

Available CTO-PCI data on patients with prior-CABG mainly derives from CTO registries in North America, Europe, and Japan.^{3,13,14} Limited published experience exists to date about CTO-

PCI outcomes in developing countries. The results achieved by operators practicing in advanced economies may not be readily translatable to developing countries, probably given reduced material (dedicated CTO wires, microcatheters, and crossing devices) availability and penetration in some regions. In addition, it is currently unknown whether the unique social and comorbidity patterns, alongside heterogeneity in operator training and interventional gear availability, could impact procedural outcomes of CTO-PCIs in patients with and without prior-CABG in developing regions. The LATAM CTO-PCI Registry was recently created to gather data on contemporary CTO-PCI practices in Latin American countries.⁴ We sought to compare clinical, angiographic, and procedural characteristics along with clinical and procedural outcomes of CTO-PCIs in patients with and without prior-CABG in Latin America.

2 | METHODS

2.1 | Patient population

The investigators developed and coordinated an ongoing international registry of CTO-PCI, the LATAM CTO registry, with support from

Instituto de Cardiologia do Rio Grande do Sul, the Brazilian Society of Interventional Cardiology, and Boston Scientific. Centers in Latin America were invited and/or volunteered to participate. There was no specific requirement regarding CTO-PCI volume for center or operator participation. Patients over 18 years old with data regarding CABG status undergoing a CTO-PCI recanalization attempt from April 2008 to June 2020 were considered eligible ($N = 1942$). Patients with data entry errors or missing information of outcome variables were excluded from the study ($n = 280$). Local institutional review boards approved the study. The authors were solely responsible for designing and conducting the study, analyzing the data, drafting, and editing the paper, along with reviewing and approving its final content before submission for publication.

2.2 | Data collection

Operators from 42 centers in eight Latin American countries added CTO-PCI data into an online platform managed by the Instituto de Cardiología do Rio Grande do Sul, Brazil. The database is available via research electronic data capture (REDCap), a secure and free-access web application developed by Vanderbilt University.¹⁵ After receiving standardized instructions for data entry in REDCap, investigators gathered clinical, procedural, angiographic, and postprocedural outcomes from this platform for analysis. In addition, all participating centers received online support for questions about inclusion or completion of cases and monthly feedback for missing data and discrepant values. Centers were also asked to address queries and internal audits to maintain the quality of the database.

2.3 | Definitions

CTO was defined as a 100% occlusion in a major coronary artery present for at least 3 months. As previously published, clinical, angiographic, procedural, and postprocedural outcomes used standard definitions from the LATAM CTO registry.⁴ In-hospital major adverse cardiac and cerebrovascular events (MACCE) were defined as the composite of all-cause mortality, myocardial infarction, stroke, and cardiac tamponade. Myocardial infarction was defined using the universal definition of MI (type 4a MI).¹⁶ Stroke was defined as a new focal neurological deficit of sudden onset of presumably cerebrovascular irreversible cause (or resulting in death) within 24 h and not caused by any other easily identifiable reason. Technical success was defined as successful CTO revascularization within the treated segment, achieving residual stenosis <30%, and restoring TIMI flow grade 3.³ Procedural success was defined as the achievement of technical success without MACCE.³

2.4 | Statistical analysis

Continuous variables are presented as mean $\pm$ standard deviation (SD), and categorical variables in frequencies and percentages.

Continuous variables were tested for differences with Student's *t*-test and categorical variables with Pearson's chi-square test and Fisher's exact test. Univariable and multivariable logistic regression was performed to evaluate the association between CABG status and the outcomes of interest. Multiple logistic regression models were adjusted by all statistically significant differing demographic characteristics (i.e., age, diabetes mellitus, dyslipidemia, hypertension, prior PCI, MI, peripheral artery disease, and ejection fraction) and J-CTO score. The results of this analysis are presented as odds ratios (OR) and 95% confidence intervals (CI). The analysis was performed using the statistical software R version 3.4.4 (The R Foundation, Vienna, Austria). A *p* value < 0.05 was considered statistically significant.

3 | RESULTS

3.1 | Baseline clinical characteristics

The final study population ($n = 1662$) was classified in two groups: no-CABG ($n = 1411$; 84.9%) and prior-CABG ($n = 251$; 15.1%) patients (Table 1). The mean age of participants was 64 ± 11 years, and female patients were 21.5% of the study sample. Compared with no-CABG patients, those with prior-CABG were older (64 ± 11 years vs. 67 ± 11 years; $p < 0.001$) (Figure 1) and had lower left ventricular ejection fraction (52.8% vs. 54.4%; $p = 0.042$). The prevalence of comorbidities such as diabetes mellitus (35.8% vs. 48.2%; $p < 0.001$), dyslipidemia (70.6% vs. 83.7%; $p < 0.001$), hypertension (86.5% vs. 93.6%; $p = 0.002$), prior PCI (49.3% vs. 57.6%; $p = 0.019$), prior myocardial infarction (40.2% vs. 48.8%; $p = 0.013$), and peripheral arterial disease (9.9% vs. 15.6%; $p = 0.010$), was higher in the prior-CABG cohort. Procedural indications were similar between groups, angina (or its equivalent) being the most frequent indication for CTO-PCI.

3.2 | Baseline angiographic characteristics

The most frequent target CTO vessel was the right coronary artery (RCA) in both groups (Table 2). In the no-CABG cohort, the RCA was followed by the left anterior descending (LAD) (37.2%) and circumflex artery (LCX) (20.5%). For prior-CABG patients, the second most common target CTO vessel was the LCX (33.7%), followed by the LAD (15.6%). Compared with no-CABG patients, prior-CABG subjects had longer CTO length (24.4 ± 13.3 vs. 28.3 ± 16.7 mm; $p < 0.001$), and higher prevalence of blunt stump (49.1% vs. 56.5%; $p = 0.038$), moderate/severe calcification (43.9% vs. 62.3%; $p < 0.001$), proximal cap ambiguity (28.3% vs. 39.0%; $p = 0.001$), moderate/severe tortuosity (18.9% vs. 29.3%; $p < 0.001$), bifurcation at distal cap (29.9% vs. 47.0%; $p < 0.001$), and a prior CTO PCI attempt (14.7% vs. 20.2%; $p = 0.030$). The prevalence of in-stent CTOs, characteristics of the collateral circulation, and the Werner score were similar between groups. Anatomic complexity was higher in the prior-CABG group (J-CTO score: 2.1 ± 1.2 vs. 2.5 ± 1.2 ; PROGRESS CTO score: 0.9 ± 0.9 vs. 1.3 ± 0.9 ; $p < 0.001$) (Figure 1).

TABLE 1 Patient baseline clinical characteristics

Variable	No-CABG (n = 1411)	Prior-CABG (n = 251)	p value
Female gender	308 (21.8)	49 (19.5)	0.461
Age, years	64 ± 11	67 ± 11	<0.001
White race	836 (59.2)	153 (61.2)	0.610
Diabetes mellitus	504 (35.8)	121 (48.2)	<0.001
Dyslipidemia	992 (70.6)	210 (83.7)	<0.001
Hypertension	1219 (86.5)	235 (93.6)	0.002
Smoking	253 (18.1)	43 (17.3)	0.848
BMI, kg/m ²	28.07 ± 4.27	27.61 ± 4.48	0.118
Prior PCI	695 (49.3)	144 (57.6)	0.019
Prior MI	564 (40.2)	122 (48.8)	0.013
Prior stroke	51 (3.6)	9 (3.6)	1.000
Peripheral artery disease	139 (9.9)	39 (15.6)	0.010
Heart failure	163 (11.6)	38 (15.2)	0.134
Creatinine clearance <30 ml/min	22 (3.2)	5 (3.8)	0.907
Ejection fraction %	54.4 ± 11.7	52.8 ± 12.8	0.042
Procedural indications			0.098
Angina control	829 (59.0)	127 (50.8)	
Moderate/large ischemia	402 (28.6)	87 (34.8)	
Chronic heart failure	127 (9.0)	27 (10.8)	
Ventricular arrhythmia	15 (1.1)	5 (2.0)	
Other	31 (2.2)	4 (1.6)	

Note: Values are mean ± SD or n (%).

Abbreviations: BMI, body mass index; MI, myocardial infarction; PCI, percutaneous coronary intervention.

3.3 | Procedural characteristics

Femoral access was used more frequently in the prior-CABG group (62.2% no-CABG vs. 86.7% prior-CABG) (Table 3). Fluoroscopy time (42.2 ± 47.8 no-CABG vs. 53.2 ± 37.3 prior-CABG min) and contrast volume (245 ± 113.7 no-CABG vs. 271.5 ± 134 prior-CABG ml) were higher in the prior-CABG group ($p < 0.001$) (Figure 1). The planned initial versus successful crossing strategy distribution differed between groups. Antegrade wire escalation was the most frequent planned initial (92.8% no-CABG vs. 80.2% prior-CABG) and successful (80.5% no-CABG vs. 67.9% prior-CABG) crossing strategy for both groups ($p < 0.001$ for both). There was a higher utilization of the retrograde approach (10% no-CABG vs. 15.8% prior-CABG) and antegrade dissection and re-entry (ADR) (9.5% no-CABG vs. 16.3% prior-CABG) as the final successful strategy in patients in the prior-CABG group ($p < 0.001$). The use of intravascular imaging was similar between the study groups (19.9% vs. 21.5%, $p = 0.420$).

complications, in particular coronary perforations (3.5% no-CABG vs. 5.2% prior-CABG, $p = 0.256$) and cardiac tamponade (0.9% vs. 0.0%, $p = 0.147$) (Table 4). Also, no differences were noted in the incidence of MACCE (3.8% no-CABG vs. 4.4% prior-CABG), myocardial infarction (1.6% no-CABG vs. 3.6% prior-CABG), stroke (0.7% no-CABG vs. 0.4% prior-CABG) cardiogenic shock (1.3% no-CABG vs. 1.6% prior-CABG), or all the other clinical outcomes. Technical (86.6% vs. 78.8%, $p = 0.002$) and procedural success rates (85.4% vs. 77.2%, $p = 0.001$) were lower in the prior-CABG cohort. Adjusted analyses confirmed the unadjusted findings, with prior-CABG status being associated with a lower adjusted rate of technical and procedural success and a similar risk of in-hospital complications. Although multiple logistic regression did not show any significant associations between clinical outcomes and history of CABG, there was a clear relationship between technical and procedural success and the absence of prior-CABG (OR: 0.67, 95% CI: 0.46–0.97, $p = 0.035$; and OR: 0.65, 95% CI: 0.45–0.95, $p = 0.026$; respectively) (Figure 1).

3.4 | Clinical and procedural outcomes

Figure 2 shows the relationship between CABG status and study outcomes. There were no differences in the incidence of periprocedural

4 | DISCUSSION

To the best of our knowledge, this study represents the first report on CTO-PCI outcomes between patients with and without a history

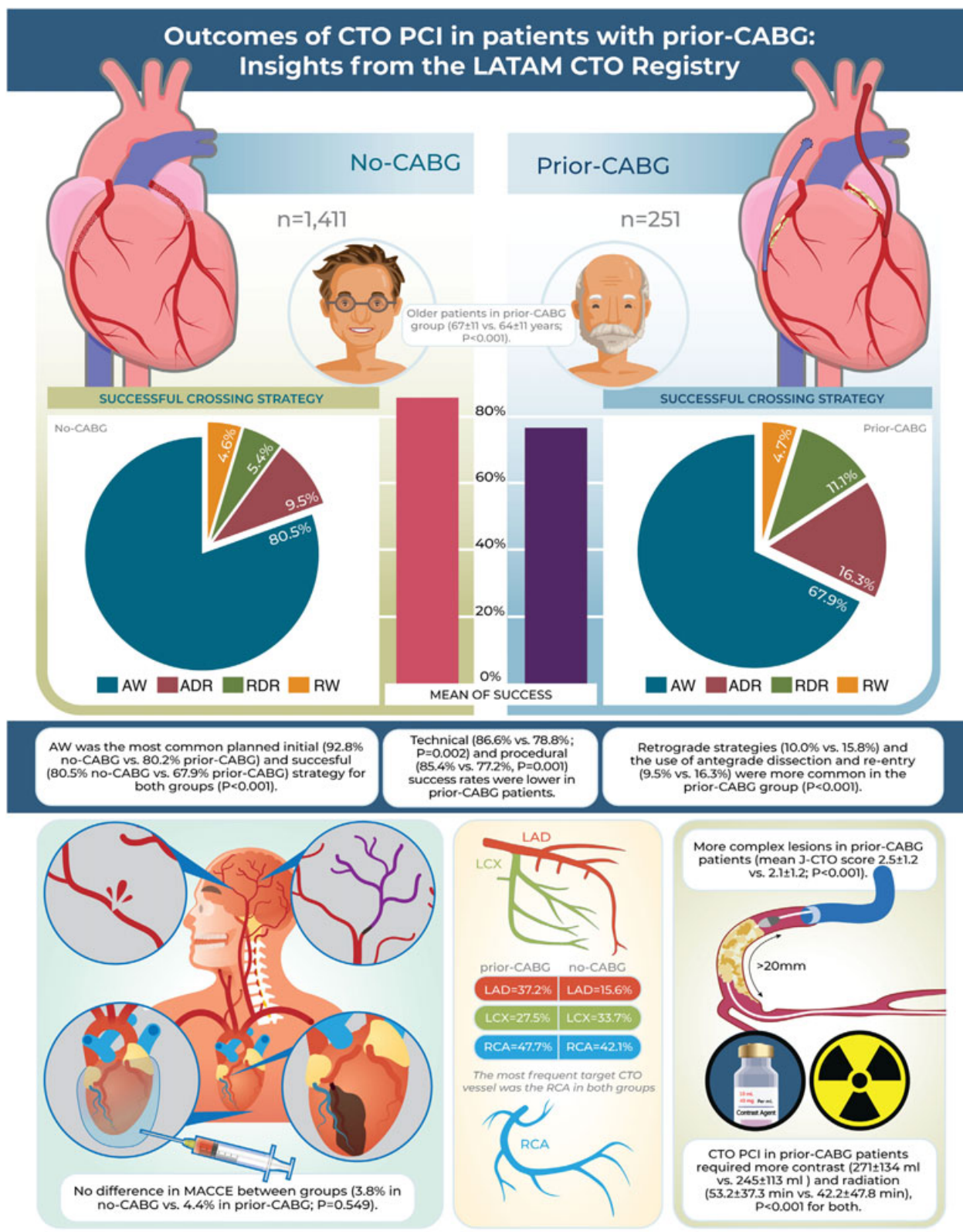


FIGURE 1 Central illustration summarizing the main findings of the study. ADR, antegrade dissection re-entry; AW, antegrade wiring; CABG, coronary artery bypass graft; CTO, chronic total occlusion; LAD, left anterior descending; LCX, left circumflex; MACCE, adverse cardiac and cerebrovascular events; RCA, right coronary artery; RDR, retrograde dissection re-entry; RW, retrograde wiring [Correction added on December 27, 2021, after first online publication: Figure-1 was updated.] [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 2 Angiographic baseline characteristics

Variable	No-CABG (n = 1411)	Prior-CABG (n = 251)	p value
Target vessel			<0.001
Left main	3 (0.2)	7 (2.9)	
LAD	518 (37.2)	38 (15.6)	
LCX	285 (20.5)	82 (33.7)	
RCA	587 (42.1)	116 (47.7)	
Length, mm	24.4 ± 13.3	28.3 ± 16.7	<0.001
In-stent CTO	165 (12.2)	39 (16.0)	0.128
Proximal cap blunt stump	657 (49.1)	139 (56.5)	0.038
Moderate/severe calcification	596 (43.9)	154 (62.3)	<0.001
Proximal cap ambiguity	379 (28.3)	96 (39.0)	0.001
Moderate/severe tortuosity	253 (18.9)	72 (29.3)	<0.001
Bifurcation at distal cap	380 (29.9)	109 (47.0)	<0.001
Lack of interventional collaterals	561 (42.0)	117 (47.6)	0.120
>45° Angulation of target vessel	538 (40.4)	95 (38.6)	0.650
Prior PCI attempt	201 (14.7)	50 (20.2)	0.030
Werner score			0.330
0	335 (25.4)	73 (29.8)	
1	658 (49.8)	117 (47.8)	
2	328 (24.8)	55 (22.4)	
Prediction scores			
J-CTO	2.10 ± 1.22	2.46 ± 1.19	<0.001
PROGRESS CTO	0.91 ± 0.85	1.28 ± 0.89	<0.001

Note: Values are mean ± SD or n (%).

Abbreviations: CTO, chronic total occlusion; PCI, percutaneous coronary intervention.

TABLE 3 Procedural characteristics

Variable	No-CABG (n = 1411)	Prior-CABG (n = 251)	p value
Radial access	524 (37.8)	33 (13.3)	<0.001
Femoral access	861 (62.2)	216 (86.7)	<0.001
Intravascular imaging (OCT or IVUS)	249 (19.9)	45 (21.5)	0.420
Fluoroscopy time, min	42.2 ± 47.8	53.2 ± 37.3	<0.001
Contrast volume, ml	245.5 ± 113.7	271.5 ± 134.0	<0.001
Initial strategy used			<0.001
AW	1220 (92.8)	194 (80.2)	
ADR	28 (2.1)	15 (6.2)	
RW	4 (0.3)	4 (1.7)	
RDR	63 (4.8)	29 (12.0)	
Successful strategy			<0.001
AW	947 (80.5)	129 (67.9)	
ADR	112 (9.5)	31 (16.3)	
RW	54 (4.6)	9 (4.7)	
RDR	64 (5.4)	21 (11.1)	

Note: Values are mean ± SD or n (%).

Abbreviations: ADR, antegrade dissection re-entry; AW, antegrade wiring; IS-CTO, in-stent chronic total occlusion; IVUS, intravascular ultrasound; RDR, Retrograde dissection re-entry; RW: retrograde wiring.

of CABG from a developing region.¹⁷ In this large international cohort from Latin America, the main findings from our analysis are: (1) patients with prior-CABG were older and had more

comorbidities; (2) use of femoral access, fluoroscopy time, and contrast volume was higher in the prior-CABG group; (3) lesions in the prior-CABG cohort were more complex and required more

advanced techniques (antegrade dissection/re-entry and the retrograde approach) for recanalization; (4) clinical outcomes were similar between groups, but success rates were lower in patients with prior-CABG (Figure 1).

Surgical revascularization is known to influence the endothelial function of bypassed coronary arteries adversely. Grafted vessels have almost four times the risk of atherosclerotic plaque progression than non-grafted arteries, and the bypassed segments are characterized by a higher calcification burden.^{17,18} Abnormal flow patterns

leading to disturbed shear stress have been described as a cause for accelerated atherosclerosis.¹⁹ Blood stasis alongside these abnormal flow dynamics may be linked to disproportionate calcification seen in native coronary arteries of post-CABG patients.^{17,20} Once a CTO develops proximal to the grafting site, systemic blood pressure (compared to collateral pressure in non-grafted coronary arteries) at the distal cap may lead to adverse remodeling and localized increased calcium burden.¹⁷ Vessel remodeling, severe calcification, and altered cap geometry (with a higher prevalence of blunt stump) may negatively impact the success rate of CTO PCI.

Previous studies have shown that post-CABG patients have a lower success rate for CTO PCI when compared to CABG-naïve patients.^{3,21,22} Along these lines, registry data have also shown that a history of CABG is more frequent among patients with failed CTO PCI.^{23–25} Notably, previous CABG is considered in two CTO complexity scores (CASTLE and RECHARGE) as a predictor of procedural failure.^{11,12} In addition, in our cohort prior-CABG patients were more likely to have the left circumflex as the target CTO vessel. Notably, circumflex CTO was shown to be associated to a higher risk of technical failure by itself.²⁶ While the imbalance in target vessel is unlikely to account entirely for the difference in outcomes between no-CABG and prior-CABG groups, a contribution of the increased proportion of circumflex CTOs to lower technical success rates in the prior-CABG group cannot be excluded.

While most of the currently available literature points at lower procedural success rates among patients with prior-CABG, data regarding procedural safety are less consistent. For example, Azzalini et al. reported an increased risk of major complications among patients with prior-CABG, mainly driven by an increased risk of perforation, periprocedural myocardial infarction, and death.³ Other reports did not show any significant difference in in-hospital adverse events, including complications and mortality.^{21,22,27} In line with previous

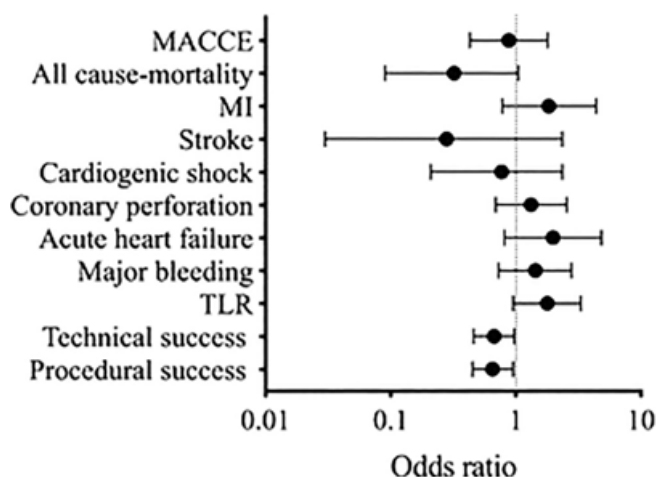


FIGURE 2 Clinical and procedural outcomes of CTO-PCI in patients with and without prior-CABG. CABG, coronary artery bypass surgery; CI, confidence intervals; MACCE, major adverse cardiac and cerebrovascular events; MI, myocardial infarction; OR, odds ratios; TLR, target-lesion revascularization. Asterisk indicates adjusted for demographics (i.e., age, diabetes mellitus, dyslipidemia, hypertension, prior PCI, prior MI, and peripheral artery disease) and J-CTO score

TABLE 4 Clinical and procedural outcomes of CTO-PCI in patients with and without prior-CABG

Outcome	No-CABG (n = 1411)	Prior-CABG (n = 251)	p value	OR crude (95% CI)	p value	OR adjusted (95% CI) ^a	p value
MACCE, n(%)	53 (3.8)	11 (4.4)	0.766	1.17 (0.61–2.28)	0.635	0.88 (0.43–1.80)	0.720
All-cause-mortality, n(%)	41 (2.9)	3 (1.2)	0.180	0.40 (0.12–1.32)	0.132	0.32 (0.09–1.05)	0.060
MI, n(%)	23 (1.6)	9 (3.6)	0.068	2.24 (1.03–4.91)	0.043	1.84 (0.78–4.37)	0.163
Stroke, n(%)	10 (0.7)	1 (0.4)	0.369	0.56 (0.07–4.40)	0.582	0.28 (0.03–2.35)	0.243
Cardiogenic shock, n(%)	19 (1.3)	4 (1.6)	0.760	1.19 (0.40–3.53)	0.755	0.77 (0.21–2.78)	0.685
Coronary perforation, n(%)	49 (3.5)	13 (5.2)	0.256	1.52 (0.81–2.85)	0.191	1.32 (0.69–2.55)	0.404
Cardiac tamponade, n(%) ^b	14 (1.0)	0 (0.0)	0.150	-	-	-	-
Acute heart failure, n(%)	21 (1.5)	9 (3.6)	0.041	2.46 (1.12–5.44)	0.026	1.98 (0.81–4.84)	0.135
Major bleeding, n(%)	42 (3.0)	13 (5.2)	0.108	1.78 (0.94–3.37)	0.076	1.43 (0.73–2.80)	0.291
TLR, n(%)	47 (3.3)	15 (6.0)	0.063	1.84 (1.02–3.35)	0.045	1.78 (0.95–3.33)	0.073
Technical success, n(%)	1206 (86.6)	197 (78.8)	0.002	0.58 (0.41–0.83)	0.001	0.65 (0.45–0.95)	0.026
Procedural success, n(%)	1190 (85.4)	193 (77.2)	0.001	0.58 (0.42–0.81)	0.001	0.67 (0.46–0.97)	0.035

Abbreviations: CABG, coronary artery bypass surgery; CI, confidence intervals; MACCE, major adverse cardiac and cerebrovascular events; MI, myocardial infarction; OR, odds ratios; TLR, target-lesion revascularization.

^aAdjusted by demographics (i.e., age, diabetes mellitus, dyslipidemia, hypertension, prior PCI, prior MI, and peripheral artery disease) and J-CTO score.

^bLogistic regression is not applicable since one of the study groups had zero events for cardiac tamponade.

findings, our data confirmed greater CTO complexity and lower success rates among CABG patients, who also tended to be older and have a higher prevalence of comorbidities. Of note, despite higher patient and procedural complexity, we did not detect any difference in terms of significant periprocedural complications between prior-CABG and no-CABG patients. This finding is reassuring regarding the safety of performing CTO PCI with an appropriate clinical indication in this patient cohort. Interestingly, there were no tamponade events in the prior-CABG group in our series. It must be emphasized, though, that cardiac tamponade can still happen in CABG patients due to the compressive effects of a loculated intramural hematoma or bleeding into the adhered pericardial space from PCI complications.²⁸

Of note, previous reports were derived from registries that did not include or included only a minimal proportion of patients undergoing CTO PCI in developing countries. The LATAM CTO initiative represents a unique dataset and a valuable resource to understand patterns of interventional cardiology practice outside developed economies. Indeed, dedicated crossing devices, newest generation guide wires, high-performance microcatheters, and, possibly, access to advanced training or proctorship were not widespread in this region, potentially impacting success rates, and patient outcomes.

While the results presented in this manuscript are mostly in line with previously published reports, some peculiarities should be highlighted and interpreted in the context of having operators from all experience levels entering data in the registry. First, the overall procedural success rates were slightly lower than what has previously been reported in both the prior-CABG and the no-CABG groups.^{22,29} Second, the use of intravascular imaging was low compared to other cohorts.³⁰ Third, the proportion of patients in whom antegrade dissection/re-entry or the retrograde approach was employed and ultimately succeeded is lower than previously reported.²⁹ Notably, the choice of strategy could be influenced by interventional gear and specific training availability. A shortfall in either could negatively impact the possibility of taking advantage of the full spectrum of the hybrid CTO algorithm⁹ and ultimately influence the procedural outcome.

4.1 | Limitations

Although the strength of this report lies in the “real-world” clinical practice in our region, some limitations need to be acknowledged. First, these findings might not be replicable in other populations. Second, given the observational design of our study, residual confounders might account for some of our results. Third, core-lab analysis of angiographic and procedural data was not available, and all characteristics were site-reported by the local investigators. Finally, outcomes were not adjudicated by a clinical event committee and were site-reported as well.

5 | CONCLUSION

In Latin America, CTO PCI in patients with CABG history is performed with high success and low complication rates. Although

clinical outcomes and complications were independent of CABG history in our real-world cohort, technical and procedural success rates during CTO PCI were lower in patients with prior-CABG. Further studies with prospective data collection, larger sample size, and core-lab adjudication are awaited to better understand this population in the context of operator expertise and resources available in the region.

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CONFLICT OF INTEREST

Dr. Azzalini has received honoraria from Abiomed, Teleflex, Asahi Intecc, Philips, Abbott Vascular, and Cardiovascular Systems, Inc. Dr. Tinoco Receives proctoring and speaker fees from Boston Scientific. Dr. Lamelas receives proctoring honoraria from Edwards Lifesciences, Medtronic, Boston Scientific (significant), and consulting fees from Boston Scientific (nonsignificant). Dr. Martins received proctoring, speaker, consultant honoraria from Boston Scientific, Terumo, and Teleflex. Dr. Damas has received honoraria from Abbot, Boston Scientific, Biotronik, Medstent, and Terumo. Dr. Padilla receives consulting and proctoring honoraria from Boston Scientific, Medtronic, and Terumo. Dr. Alcantara is an ADR (stingray/crossboss) therapy proctor for Boston Scientific and receives speaker honoraria from Abbott. Dr. Echavarria is a proctor for Boston Scientific and a speaker for Abbott, Medtronic, Medstent, and Terumo. Dr. Del Rio is a speaker for AstraZeneca, Zoll, Phillips, and Medtronic. Dr. Quadros has received educational support from Boston, Asahi, Biotronik, and Terumo, research grants from Boston and Terumo, and is a speaker for Boston. Dr. Santiago received proctoring, speaker, consultant honoraria from Boston Scientific, Abbott Vascular, Medtronic, and Teleflex, and speaker, consultant honoraria from Abiomed. The other authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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