JACC: CARDIOVASCULAR INTERVENTIONS
VOL. 10, NO. 21, 2017

ISSN 1936-8798/$36.00
https://doi.org/10.1016/j.jcin.2017.09.008

EDITORIAL COMMENT

CTO PCI in Patients With Diabetes Mellitus

Sweet Perspectives*

Marco Roffi, MD,[a] Juan F. Iglesias, MD[b]

Notwithstanding the lack of definite randomized evidence on the beneficial effects of percutaneous coronary intervention (PCI) for chronic total occlusions (CTO) compared with medical therapy, observational cohort studies have shown that successful CTO PCI, as opposed to a failed procedure, is associated with improved outcomes including lower risk of mortality, major adverse cardiac events, residual angina, and need for coronary artery bypass grafting (CABG) (1). Nonetheless, CTO recanalization is underused worldwide, with the exception of dedicated high-volume CTO PCI centers (2,3). The likely reasons are that, in comparison with non-CTO PCI, CTO recanalization has higher procedural complexity, lower procedural success rates, higher risks of complications, increased radiation exposure to patient and operator, and requires dedicated skills and equipment (3). The field of CTO PCI has substantially evolved over recent years because of dedicated technology and techniques, and greater operator's experience (3). When performed by highly experienced operators, the hybrid approach for CTO PCI, which entails a tailored strategy (i.e., antegrade vs. retrograde approach and intraluminal vs. subintimal lesion crossing), conveyed high (>90%) procedural success and low complication rates (4-6).

Patients with diabetes mellitus (DM) represent a high-risk patient subset. Patients with DM have more extensive and complex atherosclerotic coronary artery disease (CAD) compared with individuals without DM, including higher rates of CTO lesions, multivessel disease, diffuse CAD, small vessel disease, and coronary artery calcifications (7). CTO lesions have been shown to be the strongest independent predictor of incomplete revascularization among patients undergoing PCI (8). Patients with DM and incomplete revascularization have an increased risk of long-term cardiovascular events including death, myocardial infarction, stroke, and repeat revascularization compared with individuals with DM completely revascularized, irrespective of the revascularization modality (PCI or CABG) (9). Current randomized evidence based on the FREEDOM trial and subgroup analyses of the SYNTAX study supports CABG over first-generation drug-eluting stent-based PCI as the revascularization modality of choice for patients with DM with advanced multivessel CAD (10,11).

SEE PAGE 2174

In this issue of *JACC: Cardiovascular Interventions*, Salisbury et al. (12) expand the knowledge on outcomes of CTO PCI in patients with DM by reporting technical success, procedural complications, and health status outcomes in a retrospective subgroup analysis of 412 patients with DM enrolled in the OPEN-CTO (Outcomes, Patient Health Status, and Efficiency in Chronic Total Occlusion) study (12). OPEN-CTO was a single-arm, prospective, registry that enrolled consecutive patients who underwent attempted CTO PCI using the hybrid approach at 12 U.S. high-volume centers between January 2014 and July 2015 (6). The prevalence of DM in the study was high (41%), a comparable finding with other contemporary large-scale CTO registries (13,14). Most (94%) of the patients had type 2 DM, the mean duration of

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Interventions* or the American College of Cardiology.

From the [a]Cardiology Division, Geneva University Hospital, Geneva, Switzerland; and the [b]Cardiology Department, Lausanne University Hospital, Lausanne, Switzerland. Dr. Roffi has received institutional research funding from Abbott Vascular, Medtronic, Biotronik, Boston Scientific, and Terumo; and speaker fees from AstraZeneca and Cordis. Dr. Iglesias has received institutional research funding from Biotronik and AstraZeneca; institutional educational funding from Philips Volcano; and honoraria/speaker fees from Biotronik, Terumo, Medtronic, Philips Volcano, and AstraZeneca.

the disease was 14 years, and one-third of individuals were treated with insulin. The registry included patients with very complex occlusions, and this was particularly true for the DM subset (mean J-CTO score 2.4 ± 1.3 in patients with vs. 2.3 ± 1.2 in individuals without DM [p = 0.028], and corresponding mean CTO length 63.7 ± 29.1 mm vs. 59.1 ± 27.9 mm [p = 0.012]).

The authors report significantly lower crude technical success rates of CTO PCI among patients with DM compared with individuals without DM (83.5% vs. 88.1%; p = 0.04), but the difference was no longer significant after adjustment for baseline characteristics, CAD complexity, and prior CABG. In addition, there were no differences in technical success rates among patients with DM not requiring or requiring insulin, although the number of individuals in the latter group was small (n = 154). Moreover, no significant differences were observed with respect to major procedural complications rates, including any perforation (9.5% vs. 8.3%), pericardial effusion (2.2% vs. 2.9%, of which nearly half were hemodynamically relevant in both groups), emergent CABG (0.2% vs. 0.9%), contrast nephropathy (1.2% vs. 0.2%), and access site hematoma (3.9% vs. 4.6%) in patients with and without DM, respectively. The high technical success and low complication rates among patients with DM represent a remarkable performance considering the complexity of the lesions treated. The low and similar rates of the combined outcome of death, myocardial infarction, stroke, emergent CABG, or perforation requiring treatment among patients with and without DM (6.8% vs. 7.1%; p = 0.832) are noteworthy. Finally, the authors reported both in patients with and without DM similar major and sustained symptom improvement with respect to angina burden, quality of life, and overall health status scores, as assessed by the standardized Seattle Angina Questionnaire and the Rose Dyspnea Scale.

It is important to underscore the multiple strengths of the OPEN-CTO registry, including the enrollment of all consecutive CTO procedures in the participating centers, as confirmed by an audit, the systematic use of core laboratory adjudicated outcomes, and the unique comprehensive assessments of angina and its equivalents (15). The findings of the present analysis are consistent with the results of 2 recent large-scale registries focused on procedural outcomes in patients with DM undergoing CTO PCI (13,14). Both have shown similar procedural success rates and low incidence of major adverse cardiac events. Overall, the results of the present study show that in experienced hands, CTO PCI result in high procedural success rates, low complication rates, and sustained health status improvement in patients with and without DM. Therefore, in the presence of a sound indication for CTO PCI, the entire armamentarium of skills, techniques, and equipment should not be withheld to patients with DM, given the high likelihood of success free of major complications.

ADDRESS FOR CORRESPONDENCE: Dr. Marco Roffi, Cardiology Division, Interventional Cardiology Unit, University Hospital, Rue Gabrielle-Perret-Gentil 4, 1211 Geneva 14, Switzerland. E-mail: marco.roffi@hcuge.ch.

REFERENCES

1. Christakopoulos GE, Christopoulos G, Carlino M, et al. Meta-analysis of clinical outcomes of patients who underwent percutaneous coronary interventions for chronic total occlusions. Am J Cardiol 2015;115:1367–75.

2. Brilakis ES, Banerjee S, Karmpaliotis D, et al. Procedural outcomes of chronic total occlusion percutaneous coronary intervention: a report from the NCDR (National Cardiovascular Data Registry). J Am Coll Cardiol Intv 2015;8:245–53.

3. Azzalini L, Vo M, Dens J, Agostoni P. Myths to debunk to improve management, referral, and outcomes in patients with chronic total occlusion of an epicardial coronary artery. Am J Cardiol 2015;116:1774–80.

4. Christopoulos G, Karmpaliotis D, Alaswad K, et al. Application and outcomes of a hybrid approach to chronic total occlusion percutaneous coronary intervention in a contemporary multicenter US registry. Int J Cardiol 2015;198:222–8.

5. Maeremans J, Walsh S, Knaapen P, et al. The hybrid algorithm for treating chronic total occlusions in Europe: the RECHARGE Registry. J Am Coll Cardiol 2016;68:1958–70.

6. Sapontis J, Salisbury AC, Yeh RW, et al. Early procedural and health status outcomes after chronic total occlusion angioplasty: a report from the OPEN-CTO Registry (Outcomes, Patient Health Status, and Efficiency in Chronic Total Occlusion Hybrid Procedures). J Am Coll Cardiol Intv 2017;10:1523–34.

7. Roffi M, Angiolillo DJ, Kappetein AP. Current concepts on coronary revascularization in diabetic patients. Eur Heart J 2011;32:2748–57.

8. Farooq V, Serruys PW, Garcia-Garcia HM, et al. The negative impact of incomplete angiographic revascularization on clinical outcomes and its association with total occlusions: the SYNTAX (Synergy Between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery) trial. J Am Coll Cardiol 2013;61:282–94.

9. Schwartz L, Bertolet M, Feit F, et al. Impact of completeness of revascularization on long-term cardiovascular outcomes in patients with type 2 diabetes mellitus: results from the Bypass Angioplasty Revascularization Investigation 2 Diabetes (BARI 2D). Circ Cardiovasc Interv 2012;5:166–73.

10. Kappetein AP, Head SJ, Morice MC, et al., SYNTAX Investigators. Treatment of complex coronary artery disease in patients with diabetes: 5-year results comparing outcomes of bypass surgery and percutaneous coronary intervention in the SYNTAX trial. Eur J Cardiothorac Surg 2013;43:1006–13.

11. Farkouh ME, Domanski M, Sleeper LA, et al., FREEDOM Trial Investigators. Strategies for multivessel revascularization in patients with diabetes. N Engl J Med 2012;367:2375–84.

12. Salisbury AC, Sapontis J, Grantham JA, et al. Outcomes of chronic total occlusion percutaneous coronary intervention in patients with diabetes: insights from the OPEN CTO registry. J Am Coll Cardiol Intv 2017;10:2174–81.

13. Martinez-Parachini JR, Karatasakis A, Karmpaliotis D, et al. Impact of diabetes mellitus on acute outcomes of percutaneous coronary intervention in chronic total occlusions: insights from a US multicentre registry. Diabet Med 2017; 34:558–62.

14. Sanguineti F, Garot P, O'Connor S, et al. Chronic total coronary occlusion treated by percutaneous coronary intervention: long-term outcome in patients with and without diabetes. EuroIntervention 2017;12:e1889–97.

15. Sapontis J, Marso SP, Cohen DJ, et al., OPEN CTO Study Group. The outcomes, patient health status, and efficiency in chronic total occlusion hybrid procedures registry: rationale and design. Coron Artery Dis 2017; 28:110–9.

KEY WORDS chronic total occlusion, diabetes mellitus, outcome, percutaneous coronary intervention, quality of life, revascularization