

EDITOR'S PAGE



CTO—Chronic Total Occlusions and Continuous Training Opportunity



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Among the incontrovertible facts in interventional cardiology over its now 40-year history is that the percentage of procedures which are clinically successful has steadily and markedly increased. Restenosis was the largest contributor to composite outcome event rates, but recent rates of clinical restenosis or target lesion revascularization have decreased roughly 10-fold, from 40% in the early balloon angioplasty era to approximately 4% in the current-generation drug-eluting stent era. As simply stated as this historical fact sounds, I am moved by this truly remarkable accomplishment made for our patients. Numerous factors contributed to this steady increase in success including an unwavering commitment to clinical research performed with scientific rigor, the establishment of accurate definitions and standards, and collaborative training and education.

In the quest to reduce restenosis, operators had to master new techniques and become familiar with novel equipment and concepts. Understanding intravascular imaging and coronary physiology certainly has taken added study, and regular use is fundamental to achieve best outcomes and to maintain skills. But the learning curves for usage of bare-metal stents and drug-eluting stents have not been steep. In contemporary practice, probably chronic total occlusions (CTO) remain the most difficult category of coronary artery lesions. These lesions continue to be more challenging, more time consuming, and have dynamic and relatively steep learning curves. Specifically, the successful practice of treating CTOs cannot be casual or stagnate—no dabbling allowed—or as the title plays off the “CTO” acronym, this is an area with continuous training opportunity.

In this issue of *JACC: Cardiovascular Interventions*, the editors selected several CTO-related papers and include 2 particular standouts: the first presents a new or modified algorithm for the percutaneous treatment of CTO, and the second a call for standardized definitions in the field (1,2). Harding et al. (1) from the Asian Pacific CTO Club briefly cover the highlights and success of the so-named hybrid approach algorithm championed by Brilakis et al. (3) in North America and Europe. The hybrid approach is based upon accurate and detailed angiographic assessment of both the CTO vessel and the vessel providing collaterals. After considering the anatomy and quality of the proximal cap, the distal vessel, and the collateral supply, an antegrade or retrograde approach is selected. The next step involves assessing the lesion length and favoring pursuit of the true lumen for shorter lesions and a dissection/re-entry plan if this fails or for longer lesions. In the newly presented algorithm, Harding et al. (1) use these same feature assessments although place less emphasis on lesion length and more on a combination of factors including tortuosity, calcification, and prior failed attempts. More emphasis is also placed on imaging including pre-procedural coronary computed tomography and procedural intravascular ultrasound. Importantly, the authors acknowledge the importance of experience and proficiency by recommending cases with a J-CTO score ≥ 2 be tackled by operators who have performed at least 200 CTO procedures and who can achieve a $\geq 85\%$ success rate in unselected cases. Herein may exist the opportunity (especially for dissection/re-entry cases and use of new devices) to gain proctoring or guidance.

In the paper by Ybarra et al. (2), the authors point out the fly-in-the-ointment heterogeneity among

CTO trials regarding the definitions of a CTO, procedural success, as well as endpoint definitions (e.g., major adverse events including procedure-related myocardial infarctions). They call for a CTO ARC (academic research consortium), similar to those which included stakeholders and researchers that developed formal definitions for stent thrombosis, bleeding events, and percutaneous cardiac valve procedures, to standardize reporting and facilitate comparative studies. So as you read through the several CTO-related papers in this issue (and future

issues) keep these thoughts in mind. Akin to learning new ICD-10 codes or features of electronic health record systems, standardizing study definitions has upsides and for sure provides another continuous training opportunity.

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REFERENCES

1. Harding SA, Wu EB, Lo S, et al. A new algorithm for crossing chronic total occlusions from the Asia Pacific Chronic Total Occlusion Club. *J Am Coll Cardiol Intv* 2017;10:2135-43.
2. Ybarra LF, Piazza N, Brilakis E, Grantham JA, Stone GW, Rinfret S. Clinical endpoints and key data elements in percutaneous coronary intervention of coronary chronic total occlusion studies: a call to the Academic Research Consortium for standardized definitions. *J Am Coll Cardiol Intv* 2017;10:2185-7.
3. Brilakis ES, Grantham JA, Rinfret S, et al. A percutaneous treatment algorithm for crossing coronary chronic total occlusions. *J Am Coll Cardiol* 2012;5:367-79.