Update on Coronary Chronic Total Occlusion Percutaneous Coronary Intervention

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KEYWORDS

• Chronic total occlusion • Coronary revascularization • Percutaneous coronary intervention
• Techniques • Outcomes

KEY POINTS

- Chronic total occlusions (CTOs) are common and can be treated with high success rates at experienced centers using a variety of crossing techniques and equipment.
- Several observational studies suggest clinical benefit with CTO percutaneous coronary intervention.
- Performance of randomized clinical trials is critical for further expansion and refinement of the procedure.

INTRODUCTION

Coronary chronic total occlusions (CTOs) are lesions with thrombolysis in myocardial infarction 0 flow with an estimated or known occlusion duration of 3 months or more.[1] Coronary CTOs are commonly encountered in patients with coronary artery disease undergoing coronary angiography (13.3%–52.0%).[2–6] Successful

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CTO percutaneous coronary intervention (PCI) can provide significant clinical benefits, but can also be technically challenging, requiring specialized equipment and techniques. With rapid improvement in equipment and techniques, greater than 90% success rates can be achieved in a variety of settings by experienced operators.[7,8]

The goal of this review was to summarize the clinical evidence and technical evolution of CTO PCI, with emphasis on more recent developments.

SUCCESS RATES IN CHRONIC TOTAL OCCLUSION PERCUTANEOUS CORONARY INTERVENTION

Historically, due to technical complexity and limited availability of advanced equipment and techniques, success rates have been low (approximately 70%–80%). Patel and colleagues[9] performed a systematic review and meta-analysis of 65 studies published between 2000 and 2011, including 18,061 patients: angiographic success was 77% with low incidence of major complications: death 0.2%; emergent coronary artery bypass graft surgery (CABG) 0.1%; stroke less than 0.01%; myocardial infarction 2.5%; and tamponade 0.3%. However, when complications occurred, patients had worse outcomes, as described in another meta-analysis by Khan and colleagues.[10] Procedural success increased over time, whereas the incidence of complications decreased.[9] More recently, technical success has further increased to more than 90% at experienced centers[7] (Fig. 1), even among complex patient and lesion subgroups, such as patients with prior CABG[11] in whom success rates had been significantly lower in the past.[12,13]

These improved outcomes are likely the result of significant evolution in equipment and techniques. Consistent implementation of basic principles of CTO PCI, such as use of dual injection[14] and use of microcatheters to support guidewires, is likely responsible for a large part of the improvement in outcomes. In addition to antegrade wire escalation that has traditionally been the preferred (or only) crossing strategy for many operators,[15] the development of the retrograde approach[16–18] and antegrade dissection/reentry[19–21] have revolutionized the field by providing multiple crossing options for previously "impossible" cases.

ANTEGRADE WIRE ESCALATION

Antegrade wire escalation remains the most commonly used CTO crossing technique[7] and is highly successful in simple occlusions, but often fails in more complex lesions[22] (Fig. 2). A microcatheter is advanced to the proximal cap, followed by insertion of various guidewires in an effort to penetrate and cross the occluded

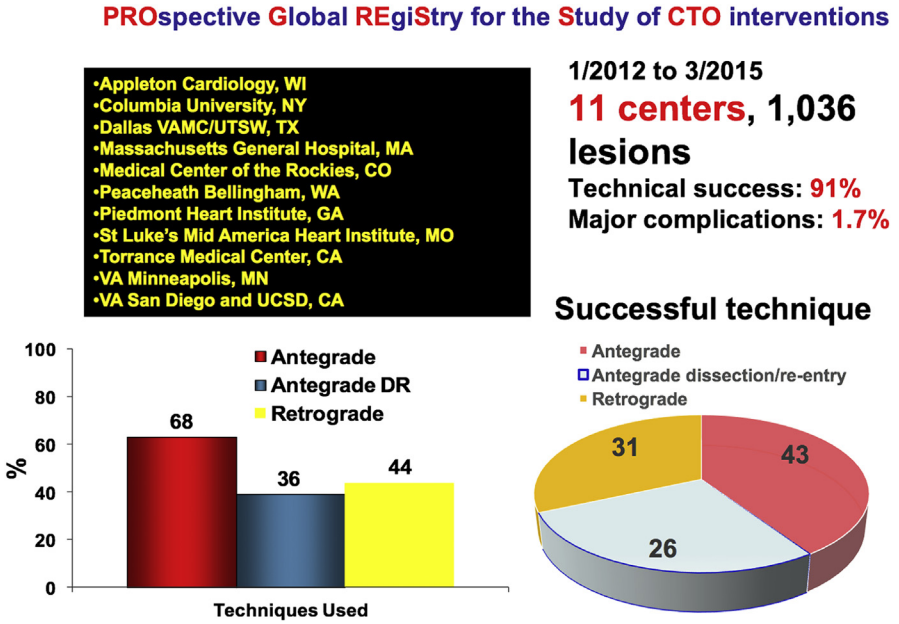

Fig. 1. Outcomes of CTO PCI in a contemporary US registry. (*From* Christopoulos G, Karmpaliotis D, Alaswad K, et al. Application and outcomes of a hybrid approach to chronic total occlusion percutaneous coronary intervention in a contemporary multicenter US registry. Int J Cardiol 2015;198:225.)