

The Retrograde Recanalization of Coronary Chronic Total Occlusion: Approaching Through the Backdoor

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Coronary Chronic Total Occlusion

Coronary chronic total occlusion (CTO), defined as occlusion in the coronary arteries with TIMI 0 flow of at least 3 months duration, is observed in 15-30% of patients undergoing diagnostic coronary angiography [1]. Percutaneous coronary intervention (PCI) of CTOs provide symptomatic relief, improves regional and global left ventricular function, quality of life and long-term survival compared to failed recanalization [2,3]. CTOs remain challenging lesions for interventional cardiologists, and have been called the 'last frontier' due to technical complexity, poor success rate, and the greater experience needed to effectively and safely perform the procedure. Despite meaningful benefit associated CTO PCI, several misconceptions prevailed: a chronically occluded artery is clinically benign; Collateral channels (CCs) are sufficient for angina relief; the area subtended by the CTO is non-viable, CTO PCI is associated with high complication rate; a lack of strong randomized data demonstrating clinical benefit. However, the relative reluctance to attempt CTO PCI is waning with improvement in the technique and technology leading to further procedural success and better outcomes. The recognition that traditional guidewire techniques were not adequate to achieve higher procedural success rates led to development of dedicated guidewires, micro catheters, innovative methods like parallel wire technique, anchor wire, anchor balloon technique, intravascular ultrasound (IVUS) guidance, side branch techniques and dissection and re-entry methods played significant roles in improving the success rate via antegrade approach [4]. Even then, the technical success rate for CTO via the antegrade approach remained suboptimal, in the range of 65%-70% worldwide. The limitations of the conventional antegrade approach are overcome by the retrograde approach that involves targeted CC crossing, retrograde lesion crossing and management of subintimal space with use of balloon dilatation for connecting antegrade and retrograde channels [5]. Adoption of this technique has potentially improved the success rate of complex CTO to the extent of 90-95%. Angiographic features of blunt occlusion with a large side branch, bridging collaterals, calcification, and long CTO are no longer considered negative predictors of

success while using a retrograde approach. This approach can be used after antegrade crossing failure or as an initial situation like ostial occlusions, long occlusions, heavy calcification, occlusions with ambiguous proximal cap, and occlusions with a diffusely diseased distal vessel, occlusion involving a distal major bifurcation and CTO vessels that are difficult to engage such as anomalous coronary arteries [4].

Retrograde approach was described in 1990 by Kahn and Hartzler [6]. The first report of retrograde crossing via septal CC was published in 2006 that revolutionized this technique with introduction of specialized equipment [7]. This was further developed by the author making this approach safer, faster and more successful [8]. The rationale of selecting the retrograde route was established by histopathologic demonstration of communications between lumen recanalization channels and intra plaque capillaries [9]. These channels have a branched tree-like configuration that spreads out from the proximal to the distal cap and this configuration may lead to subintimal navigation of antegrade guidewire. The distal cap of CTO is softer, tapered and less frequently ambiguous compared to the proximal cap, better allowing the retrograde guidewire to cross the occlusion. A retrogradely advanced guidewire can be used as a landmark for the guidewire from the antegrade approach, with the distal wire identifying the true lumen of the artery (kissing wire technique). The success rate achieved in the past with various retrograde techniques such as kissing wire, knuckle wire, and direct retrograde crossing improved with the introduction of the controlled antegrade and retrograde subintimal tracking (CART) technique where the retrogradely advanced guidewire enters a false lumen and is enlarged by inflation of the balloon, allowing the antegrade guidewire to advance to this lumen and to ultimately reach the true lumen. Reverse CART, the more reproducible and predictable technique that involved both antegrade access to the proximal cap, retrograde access to the distal cap, creation of subintimal space by antegrade balloon followed by negotiation of retrograde wire through the subintimal space into the proximal true lumen. With latest iterations described by the author such as IVUS-guided reverse CART, stent reverse CART, mother-child and contemporary reverse CART, the retrograde revolution broke out and its

effects reverberated throughout the world [10]. Another technique is the rendezvous method which uses two micro catheters advanced in an ante and retrograde manner, allowing the antegrade wire to advance to the distal part of CTO [11]. "Putting it all together" or global approach aims at CTO PCI embarking on all available techniques (antegrade, retrograde, true-to-true or intra plaque lumen crossing or re-entry) tailored to the specific case safely, effectively and efficiently [10].

It is the time to develop regional centers of excellence across the whole world to reap the benefits of CTO PCI by antegrade, retrograde, or putting it altogether strategy to every patient who needs them. While enhancing the success rate, it will decrease the risks of procedure significantly. My opinion is that "this technique should be reserved for very experienced antegrade operators (>300 CTOs and >50 per year)", although a specific threshold is hard to define.

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