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Research Letter

Problems encountered in retrograde recanalization of coronary chronic total occlusion: Should we lock the backdoor in 2018?

The retrograde (also known as backdoor) approach through collateral circulation has revolutionized percutaneous coronary intervention (PCI) of chronic total occlusion (CTO) by significantly improving procedural success rates, especially in cases with ostial occlusions, long occlusions, heavy calcification, occlusions with ambiguous proximal cap, and occlusions with a diffusely diseased distal vessel or after antegrade crossing failure. Adoption of this innovative technique has potentially increased the success rate of complex CTO by 15–20% in the past several years to reach approximately 90–95%.[1,2] With the advent of new antegrade techniques and equipments improving success rates of antegrade CTO PCI, the role of retrograde approach might change.In general, the retrograde approach carries a higher rate of complications than the antegrade one.[3]

The complications such as guidewire and balloon kinking or entrapment into collateral channel (CC), dissection, perforation and hematoma are exclusive to retrograde approach. The most common complications include CC dissection and perforation (Table 1). Many CC ruptures tend to be benign and do not require further treatment apart from abandoning that CC and trying for another. The risk of CC dissection or perforation even with excessive tortuosity has substantially diminished with currently available novel, lower profile and highly deliverable microcatheters, such as the Carvel (Asahi Intecc, Nagoya, Japan), Turnpike LP (Vascular Solutions, Minneapolis, Minnesota) and Micro 14 (Roxwood medical, Redwood City, California). While advancing the microcatheter, if septal wire shows excessive kinking, it needs to be withdrawn to prevent perforation. Septal CC perforation usually results in bleeding into a cardiac chamber and does not result in complications; however balloon dilatation or negotiation of additional device must be avoided. Perforation causing hemorrhage within the myocardium rather than the ventricle leads to gradual enlargement of hematoma which needs to be treated by hemostasis. Epicardial CC should never be dilated as perforation of this is treacherous rapidly leading to tamponade that may be difficult to control. This complication is prevented by meticulous wire manipulation through CC, ensuring position of wire prior to negotiation of microcatheter, cautious injection of contrast through its tip ensuring that back bleeding is possible prior to injection of contrast, withdrawing epicardial CC wire after ascertaining no perforation at the end of the procedure, avoiding surfing the epicardial CC. Negative pressure from the wedging microcatheter might sometimes be sufficient to seal the ruptures. Advancing microcatheter and coiling from both sides that feed the collateral might to be required to address perforations.[4] Acute obstruction ofthe donor artery due to thrombosis or dissection (Table 1) is a dreaded complication thatmay compromise the only supply of blood flow to the myocardium (given that the target artery is already occluded by the CTO) and result in rapid hemodynamic deterioration. This occurred in 0.9% of cases in Japanese multicenter registry.[6] To prevent this frightening complication, the position of the guiding catheter should be checked frequently to avoid “deep throating.” A meticulous attention paid to the pressure waveform of the donor vessel guiding catheter can minimize the risk of dissection. A guide catheter with side holes should not be used as it may mask suboptimal catheter position and flow compromise. Back bleeding and good flushing should be allowed after removal of any equipment. ACT should be monitored at least every 30 min to maintain it in between 300–350 s. Rapid stenting may be needed to prevent hemodynamic collapse in case of dissection. Aspiration thrombectomy and additional IIb/IIIa inhibitors might be required with donor vessel thrombosis.[4] Perforation is the most feared complication that can occur in large vessel, a distal branch or in a CC. Large vessel perforation is fixed with prolonged inflation of a balloon proximal to the perforation or covered stent using a dual catheter technique, whereas distal vessel and CC require embolization using coils, subcutaneous fat, clotted blood or thrombin.[4] Alternatively, a microcatheter may be navigated to the perforation site and suction applied to achieve hemostatsis.[7] The retrograde approach is associated with higher risk of periprocedural myocardial infarction. It may be also associated with longer procedure and fluoroscopy time increasing the risk for radiation skin injury. It highlights the criticality of radiation reduction strategies.

Lo et al.[8] demonstrated a myocardial injury rate of 13.8% with the retrograde approach. And 6.7% with the antegrade approach. Karmpaliotis et al.[9] reported that complications of PCI for CTO were relatively infrequent, with the rate of major complications being 2.6% and the coronary perforation rate being 1.3%. The Euro CTO Club[10] observed complications of the retrogradeapproach in 8.6% of patients, out of which CC perforation and hematoma were seen in 6.9%. A Japanese retrograde PCI registry study[11] demonstrated similar rates of major CC injury and perforation after successful and unsuccessful intervention for CTO, but a significantly higher rate of minor CC injury was observed after unsuccessful intervention (17.0 vs 7.5%). Sub-analysis of Japanese multicenter registry demonstrated low major adverse cardiac and cerebrovascular events and acceptable complications related to the retrograde approach.[6]

Karmpaliotis et al.[12] observed lower success and higher complication rates with retrograde technique as compared to antegrade-only cases.Therefore, an initial antegrade attempt may be preferred whenever feasible. This is further supported by the longer procedure times, higher contrast and radiation

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Table 1
Complications of Retrograde CTO PCI: Prevention and Bail out.[5]

Complications	Prevention	Bail out
• Coronary perforation	• Verification of guidewire position before micro-catheter advancement	• Coil and fat embolization for distal vessel & CC perforation • Covered stent/prolonged balloon inflation for lar-geperforation • ±Pericardiocentesis
• CC perforation/rupture	• Careful selection of CC • Preference septals	• Prolonged balloon inflation • Heparin neutralization • Embolization if necessary • Immediate hemostasis in epicardial CC perforation, careful observation in case of septal (fenestration or embolization if chest pain)
• Donor vessel trouble (thrombus, dissection)	• Retrograde guide position & waveform monitoring • Adequate flushing • ACT (300–350 s)	• Stenting of dissection • ±Hemodynamic support • Thrombus aspiration
• MI	• Avoid large SB dissection • ACT (300–350 s)	• Low threshold for PCI • ±Hemodynamic support
• CIN	• Adequate pre & post PCI hydration • Minimum contrast use	• Support care
• Equipment loss or entrapment	• Proper lesion preparation before device delivery	• Retrieval with snares • To leave in situ & cover with stenting
• Radiation skin injury	• Use of X-ray in need only • Radiation reducing x-ray systems	• Support care • Follow-up several weeks after PCI
• Stroke	• ACT (300–350 s) • Minimum catheter manipulation	• ±Endovascular treatment • Immediate CT

CC, collateral channel; ACT, activated clotting time; MI, myocardial infarction; CIN, contrast induced nephropathy; SB, side branch; PCI, percutaneous coronary intervention; CT, computed tomography.

requirements, larger number of stents, and more frequent use of hemodynamic support with the retrograde approach. However, retrograde attempt was a key contributor tothe overall high success rates observed in this contemporary multicenter registry (Table 2).[12] This retrospective, observational study could have suffered from selection bias. The comparison of final technical success between antegrade-only and retrograde cases may be biasedin favor of antegrade procedures, as many failed ante-gradeprocedures subsequently underwent a retrograde attempt andwere, thus, classified as retrograde. It lacked local monitoring or core laboratory adjudication ofthe angiograms or centralized clinical event adjudication.[12]

In spite of various drawbacks, the retrograde (backdoor) approach is both effective and safe if performed by experienced operators in experienced centers. The author feels that patients with J-CTO score of 0–1 could be treated in any center, but those with J-CTO score ≥2 should be treated by an experienced CTO operator, defined as someone who has performed >300 CTOs and >50 CTOs/year, although a specific threshold is hard to define.[2] "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.[2,16] No procedure is 100% effective and knowing when to stop a procedure is of paramount importance. The fear of complications should not prevent us from performing the procedure if it is significantly beneficial to the patient. The retrograde approach is certainly not burdening the interventionists, rather than a sine qua non of CTO PCI success. There is a light at the end of tunnel. The backdoor should not be locked for the time being to the interventionists in spite of some catastrophic complications, many of which, the author, can see, are easily preventable.

Table 2
Retrograde CTO PCI Series.[12]

Study	Retrograde PCI, n (%)	Primary Retrograde,%	Previous Failed CTO PCI in Retrograde Group,%	Overall Success in Retrograde Group,%	MACE in Retrograde Group, %
Kimura et al.[13]	224	100	65	92	1.8
Galassi et al.[3]	234(12)	76	U	65	3.0
Karmpaliotis et al.[8]	462(34)	46	18	81	2.6
Yamane et al.[14]	378(25)	75	32	84	0.5
Tsuchikane et al.[10]	801(27)	67	29	85	1.6
Galassi et al.[15]	1582(16)	76	43	75	0.8
Karmpaliotis et al.[12]	539(41)	46	21	85	4.3

CTO, chronic total occlusion; MACE, major adverse cardiovascular event, PCI, percutaneous coronary intervention; U, unknown.

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