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Case report

"Putting it all together": Highlighting the global approach to chronic total occlusion revascularization

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ABSTRACT

Preprocedural planning and advanced imaging is vital to achieve a consistent and high level of success for complex coronary chronic total occlusion (CTO) revascularization. Various practice patterns exist around the world when performing coronary artery CTO revascularization. This case report highlights a fusion of global practices in CTO intervention and integration of advanced imaging to achieve successful revascularization.

1. Introduction

Procedural techniques for chronic total occlusion (CTO) revascularization vary across the world; operators in the US favor the device-based hybrid approach[1] with use of the subintimal space, operators from the Asia-Pacific region advocate a wire-based approach to CTO percutaneous coronary intervention (PCI) with intent to stay within the true lumen of the vessel, and operators in Europe adopt either of these approaches. Such variability arises from practice patterns, the availability of equipment (e.g. specialized CTO wires and antegrade dissection and reentry catheters), and the cost of dedicated equipment. Showcasing integration of these international skill sets for successful revascularization of a complex CTO is the intent of this case report.

Certain validated tools, such as the J-CTO score, predict complexity of the procedure independent of the approach.[2] A score ≥ 3 is a predictor of a more complex procedure. However, there remains a clinically unmet need where patients with the most pressing clinical indication have the most challenging anatomy. They are denied revascularization because of a perceived high risk–benefit ratio of the procedure.

This case report highlights the need to combine skill sets and techniques from around the world to achieve complete revascularization for more patients with complex coronary CTOs, "putting it all together."

2. Case

A 73-year-old male with a prior history of coronary artery bypass grafting suffered an out-of-hospital cardiac arrest while on vacation. Return of spontaneous circulation (ROSC) was achieved after bystander chest compressions and defibrillation. Post-ROSC electrocardiogram did not reveal injury pattern. Coronary angiography revealed an atretic left internal mammary artery and patent grafts to the diagonal, obtuse marginal, and right coronary arteries. Proximal left anterior descending artery (LAD) was chronically occluded. The mid and distal LAD filled via a saphenous vein graft to a diagonal (Fig. 1a and b). No interventions were undertaken and the patient was recommended continued medical treatment. An automatic implantable defibrillator was implanted for secondary prevention and he was discharged back to the care of his primary cardiology team.

About 6 weeks later, a myocardial perfusion scan was performed, which demonstrated a large completely reversible myocardial perfusion defect in the anterior wall. The estimated myocardium at ischemic risk was 14% of the left ventricular mass. Based on the prior angiogram, the J-CTO score of the LAD CTO was estimated at 4 (due to a blunt stump, fluoroscopic calcification, bending within the CTO body, and a lesion length >30 mm).

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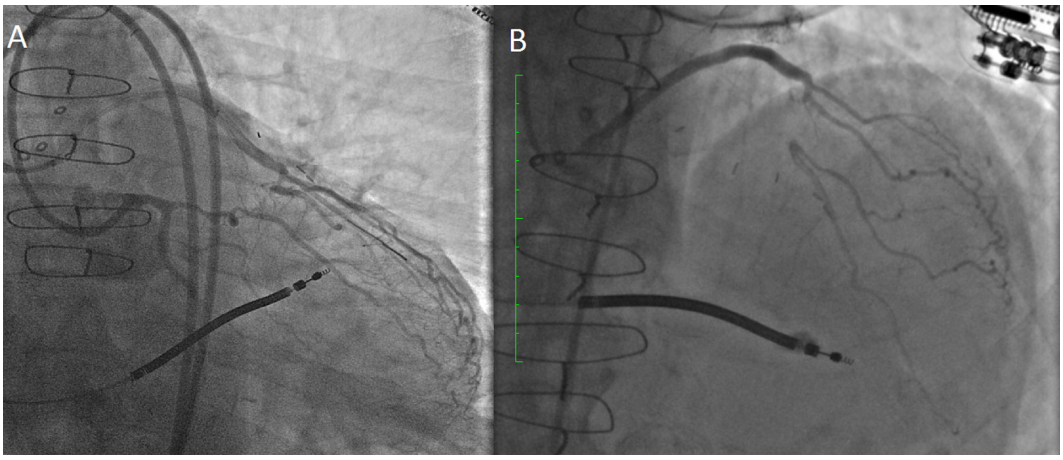

Fig. 1. CTO of the LAD that fills retrograde via collaterals from a saphenous vein graft to a diagonal branch in LAO caudal (A) and AP cranial (B) views.

Application of the hybrid algorithm to the CTO revealed the following characteristics:

1. Ambiguous proximal cap
2. Lesion length >20 mm
3. Absence of usable interventional collaterals
4. Good distal target

The ambiguous or blunt proximal cap favored a primary retrograde approach but there were no usable interventional collaterals. The presence of a previous bypass graft to the diagonal and unclear understanding of the anastomotic relationship between the saphenous vein graft, native diagonal, and the LAD made preprocedure planning of the CTO difficult. A preprocedure computerized tomographic angiogram (CTA) was performed to clarify the anatomical ambiguity associated with both the proximal and distal caps. Aligning and analyzing the multiplanar reconstruction of the CTA with the coronary angiogram in typical views that interventional cardiologists are used to interpreting, like the anteroposterior (AP) cranial and left anterior oblique (LAO) caudal view, helped clarify the anatomy (Fig. 2a and b). The CTA clarified that the large vessel on angiography previously thought to be an intermedius vessel was actually a proximal diagonal artery. It also clarified that the CTO originated 3 mm beyond the LAD ostium.

Based on this information, the decision was made to proceed with intravascular ultrasound (IVUS) guided proximal cap puncture. An Opticross (Boston Scientific, Maple Grove, MN) IVUS imaging catheter was placed in the diagonal and the origin of the CTO within the LAD was visualized and punctured using a Confianza Pro 12 wire (Asahi Intec, Nagoya, Japan) (Fig. 3). After the Confianza Pro 12 punctured the proximal cap and entered the subintimal plane, it was then expanded with a Fielder XT (Asahi Intecc, Nagoya, Japan) wire (Supplemental Video). This entry of the Confianza Pro 12 in the subintimal plane is not unexpected given the bend within the CTO body. The Cross-Boss catheter (Boston Scientific, Maple Grove, MN) was not used to limit the subintimal plane because of a healthy distal target and proximity of the knuckle wire to the distal vessel. The strategy was changed to the hybrid approach using antegrade dissection reentry with the Stingray balloon (Boston Scientific, Maple Grove, MN) and catheter within the mid LAD (Fig. 4). Since subintimal dissection planes created by a knuckle wire cannot be controlled, loss of side branches, such as septal arteries and diagonals, in this case could have occurred. However, when the Stingray system is used to perform dissection reentry, exquisite control can be maintained at the point of reentry. In this case, reentry was performed using orthogonal projections to help the Stingray wire into the true lumen of the LAD using the stick-and-swap technique. The reentry point was proximal to the distal diagonal artery and hence flow

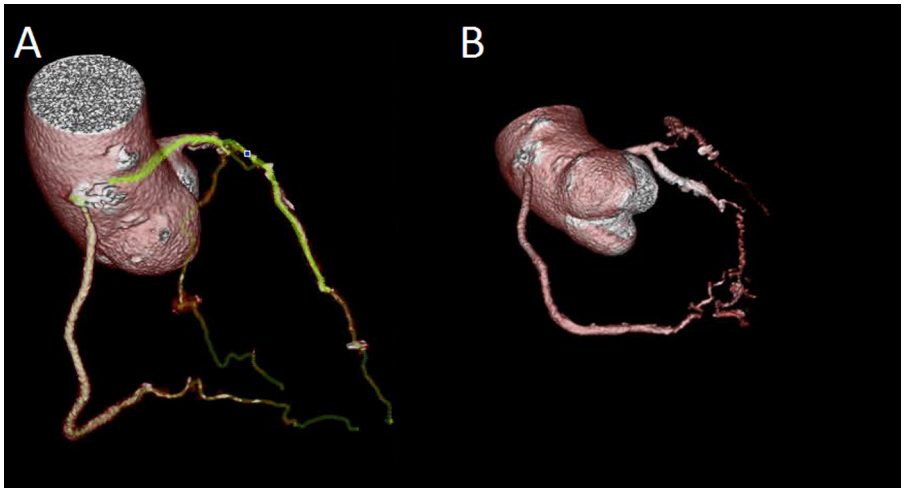

Fig. 2. 3D CT reconstruction showing the course of the occluded LAD in AP cranial (A) and LAO caudal (B) views.

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