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LETTER TO THE EDITOR

Bifurcation CTO recanalization with contemporary antegrade and retrograde techniques in a patient with two chronically occluded coronary arteries

KEYWORDS
CTO;
Chronic total occlusion;
Retrograde approach;
Collateral circulation;
J-CTO

Chronic total occlusions (CTOs) were identified in 18.4—30% of patients with coronary artery disease referred for coronary angiography in the most recent series.[1,2] Lesions with severe tortuosities, calcifications or bifurcations present technical challenges, but the success rate of treatment in dedicated centers applying new strategies remains far above 90%.[3] The perception that CTOs are challenging lesions with a low success rate, limited scope for revascularization and questionable impact on patient outcome has led to the underutilization of percutaneous techniques, with no more than 10% of all CTOs being treated and the majority of lesions being left to medical therapy or referred for surgical revascularization.[2,4] A series of studies, mainly retrospective and observational in nature, relate successful CTO recanalization to improved survival, improvements in anginal status and left ventricular function, increased exercise tolerance and decreased need for coronary artery bypass grafting (CABG).[5]

Recently, major technological advances, such as dedicated microcatheters and wires, have led to the development of novel techniques and revolutionized the field of CTO PCI.

We present a case implementing contemporary CTO and bifurcation techniques. The case concerned a 55-year old patient presented with CCS Class III angina (Canadian Cardiovascular Society Classification) on maximal antianginal medication (bisoprolol, calcium channel blocker, ranolazine). He had a history of smoking, hypertension and hyperlipidemia and no history of myocardial infarction. Echocardiography revealed the preserved ejection fraction (55%) and hypokinesia of the inferolateral left ventricular wall. Nuclear perfusion imaging (MPI) documented viability and prognostically significant ischemia, with a reversible perfusion deficit of 20—25% of the total myocardial mass. Following this, he underwent diagnostic coronary angiography that revealed a proximally occluded Right Coronary Artery (RCA) at the take-off of a Kugel-variant atrial collateral (Figure 1). The J-CTO score was 2 (no stump, lesion length 20 mm). The left circumflex (LCx) coronary artery was a bifurcation CTO involving the main vessel and the ostium of a sizeable first Obtuse Marginal (OM1) branch. The J-CTO score for this occlusion was also 2 (no stump, lesion length 20 mm).[6] The Left Anterior Descending (LAD) artery had mild wall irregularities and provided septal CC2 collateral channels to the PDA and CC2 epicardial collaterals through the first diagonal branch to the distality of the OM1.[7] Due to the high percentage of myocardium at risk and the presence of two CTOs, CABG was proposed to the patient as the best therapeutic option. The patient categorically refused surgery and, in view of his young age, was then considered for percutaneous recanalization of his occluded coronary arteries.

Incomplete revascularization (IR) related adverse clinical outcomes are strongly documented in the literature, and the presence of a CTO remains its strongest predictor.[8] Surgical CTO revascularization suffers from suboptimal mid- and long-term graft patency and is not always an option in view of the results of the most recent series, where 32% of CTO patients assigned to surgical revascularization did not eventually receive a graft in their CTO.[8—10]

Bifemoral arterial access was established with a 6 French (Fr) Extra backup 4.0 catheter (Launcher®, Medtronic, Minneapolis, MN, US) placed at the left main (LM) coronary artery and a 6 FrJudkinsRight (JR) 4 catheter (Launcher Medtronic, Minneapolis, MN, US) placed at

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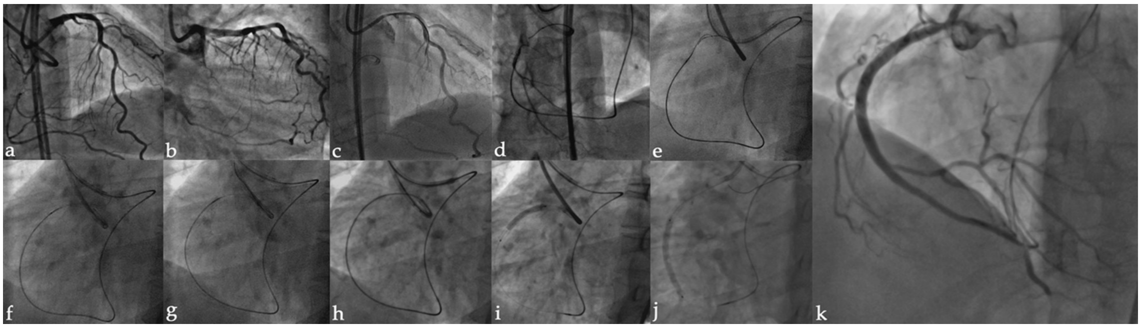

Figure 1 Right Coronary Artery (RCA) Chronic Total Occlusion (CTO) recanalization. a. Bilateral contrast injection revealing CC2 septal and epicardial connections from the Left Anterior Descending (LAD) coronary artery to the distality of the occluded RCA. b. Contralateral contrast injection delineating the collateral circulation. c. Fielder FC wire (Asahi Intecc, Aichi, Japan) supported by a Corsair microcatheter advanced in a sizeable CC2 septal collateral. d. Collateral channel crossed; Corsair advanced to the distal CTO cap over Fielder FC. Fielder FC wire supported by Finecross microcatheter (Terumo Interventional Systems, Somerset, New Jersey, US) at the proximal cap. e. Bilateral wiring of the occlusion; Gaia First (Asahi Intecc, Aichi, Japan) antegradely and Gaia Second (Asahi Intecc, Aichi, Japan) retrogradely advanced. f. Gaia Second advanced through the occlusion to the ascending aorta (pure retrograde crossing technique). g. Gaia second entering the antegrade guiding catheter. h. Corsair advanced into the antegrade guiding catheter; Gaia second exchanged with an RG3 wire (Asahi Intecc, Aichi, Japan) that was externalized. i, g. Stent implantation; Resolute Integrity 3.0×33 mm proximally and 3.0×38 mm distally (Medtronic, USA). k. Final angiographic result following postdilatation with a 3.5×20 mm Maverick balloon; TIMI (Thrombolysis In Myocardial Infarction) grade 3 flow restoration with no residual dissection in the RCA.

the ostium of the RCA. Bilateral contrast injection was performed to visualize the distality of the occluded vessels and assess the details of the occlusions.

The RCA was treated first (Figure 1). The lesion was initially approached antegradely with a Fielder FC wire (Asahi Intecc, Aichi, Japan) supported by a Finecross microcatheter (Terumo Interventional Systems, Somerset, New Jersey, US). The Fielder FC could not be advanced, and composite core wires were subsequently used but also failed to re-enter the distal true lumen (Gaia First and Gaia Third; Asahi Intecc, Tokyo, Japan) (Figure 1c). We then switched to a retrograde strategy. Applying the septal surfing technique, a Fielder FC wire was advanced through a CC2 septal collateral to the distal cap of the occlusion.[7] A Corsair microcatheter (Asahi Intecc, Aichi, Japan) was then advanced to the distal true lumen (Figure 1d). The Fielder FC was exchanged with a Gaia Second wire (Asahi Intecc, Aichi, Japan) that crossed the occlusion and reached the ascending aorta (pure retrograde crossing technique) (Figure 1f). Subsequently, the wire and the microcatheter were advanced into the antegrade guiding catheter (Figure 1g—h). The Gaia Second was then exchanged with a 330 cm RG3 wire (Asahi Intecc, Aichi, Japan) that was externalized. The procedure was then completed antegradely over the RG3 wire. Predilatation was performed with a 2.5×20 mm Maverick balloon (Boston Scientific, MA, USA), and two stents were implanted (Resolute Integrity, Medtronic, USA 3.0×33 mm proximally and 3.0×38 mm distally) (Figure 1i—j). Following postdilatation with a 3.5×20 mm Maverick balloon, TIMI (Thrombolysis In Myocardial Infarction) grade 3 flow was established at the RCA (Figure 1k).

LCX-OM1 bifurcation occlusion was considered as a two vessel CTO, and each one of them was approached separately with reference to the CTO wiring (Figure 2). Referring to the OM1, a Fielder FC wire supported by a Corsair microcatheter was advanced to the first diagonal branch. Selective contrast injection through the Corsair delineated the course of the CC2 epicardial collateral (Figure 2b). A Sion wire (Asahi Intecc, Aichi, Japan) was advanced to the distality of the occluded OM1 (Figure 2c). Corsair could not be advanced through the epicardial channel and was exchanged with a Finecross microcatheter that successfully reached the distal OM1 true lumen.

The main branch of LCX was approached antegradely. A Fielder FC wire supported by a Finecross microcatheter was easily steered through the occlusion and reached distal LCX true lumen (Figure 2d).

The OM1 occlusion was retrogradely crossed with a Gaia second wire that was advanced to the proximal part of the main LCX and the ascending aorta (pure retrograde wire crossing) (Figure 2e). The retrograde Finecross could not be advanced through the OM1 occlusion, and support was necessary to achieve that. For that purpose, the guiding from the already-recanalized RCA was removed, and a second 6Fr EBU guiding catheter (GC) was advanced to the ostium of the LM (ping pong technique). Subsequently, the Gaia second was steered into its lumen and after the trapping of the wire in the GC with a 2.0×15 mm Maverick balloon, the advancement of Finecross into this guide became possible (trapping technique, Figure 2f—g).

An RG3 wire was then externalized according to standard practices. Following these techniques, both vessels of the bifurcation were successfully wired, one antegradely and the other retrogradely. Standard techniques were followed.

After predilatation with a 2.0×20 mm Maverick balloon in both vessels, kissing balloon dilatation was performed with a 2.5×20 mm Maverick balloon in the LCX and a 2.5×15 mm Quantum balloon (Boston Scientific, MA, USA) in the OM1 (Figure 2h). Bifurcation stenting was applied with the minicrash technique (Figure 2i). Initially the stent

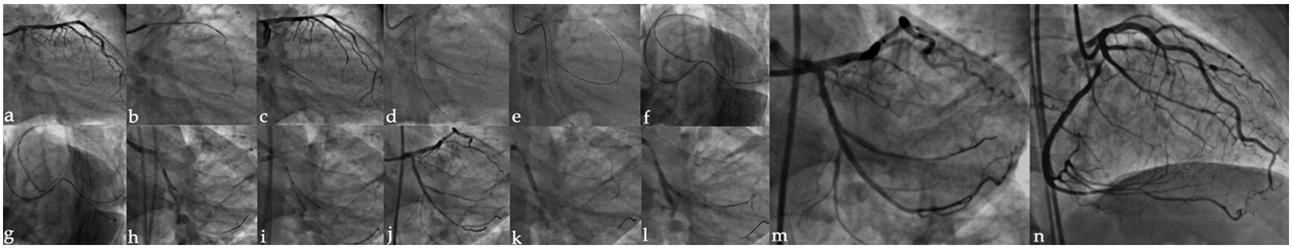

Figure 2 Left Circumflex (LCX)-Obtuse Marginal (OM1) bifurcation Chronic Total Occlusion (CTO) recanalization. a. Ipsilateral contrast injection revealing a CC2 epicardial collateral connection from the first diagonal branch (D1) to the OM1. b. Selective contrast injection through Corsair microcatheter (Asahi Intecc, Aichi, Japan) delineating the course of the collateral vessel. c. Sion wire (Asahi Intecc, Aichi, Japan) advanced through the collateral channel to the distal OM1 true lumen; Corsair cannot be advanced over the wire. d. Fielder FC wire (Asahi Intecc, Aichi, Japan) antegradely advanced to distal LCX. e. Gaia second (Asahi Intecc, Aichi, Japan) retrogradely advanced through the occlusion to the ascending aorta (pure retrograde crossing technique). f. Gaia second steered into the lumen of a second 6Fr EBU guiding catheter (GC) (ping pong technique). g. Finecross advanced in the second GC following trapping of the wire with a 2.0×15 mm Maverick balloon; wire exchange and externalization of an RG3 wire (Asahi Intecc, Aichi, Japan). h. Kissing balloon dilatation with a 2.5×20 mm Maverick balloon in LCX and 2.5×15 mm Quantum balloon (Boston Scientific, MA, USA) in OM1. i. Bifurcation stenting with minicrash technique with a 2.5×18 mm Resolute Integrity stent implanted in OM1 and a 2.5×24 mm Resolute Integrity stent implanted in LCX. j. Result following bifurcation stenting. k. Proximal optimization technique (POT). l. Kissing balloon postdilatation with a Quantum NC balloon 3.0×20 mm in the OM1 and a Quantum NC balloon 3.5×20 mm in the LCX. m. Final angiographic result with TIMI (Thrombolysis In Myocardial Infarction) grade 3 flow restoration and no residual dissection in both LCX and OM1. n. Bilateral contrast injection revealing TIMI 3 flow restoration in both RCA and LCX-OM1 with no signs of wire injury.

in the OM1 was deployed with minimal protrusion into the LCX. Before deployment of the main vessel stent, the retrograde externalized wire (RG3) was removed. Afterwards, a 2.5×24 mm Resolute Integrity stent was implanted in the main LCX. Following the proximal optimization technique (POT), a Fielder FC wire was antegradely steered to the OM1, and Kissing balloon postdilatation was performed with a 3.0×20 mm Quantum NC balloon in the OM1 and a 3.5×20 mm Quantum NC balloon in the LCX (Figure 2j–l). TIMI grade 3 flow was established in both branches with no signs of wire injury (Figure 2m–n).

Thanks to increasing operator experience and the refinement of the retrograde approach, CTO PCI is currently achieving high technical and procedural success rates and serves as an efficient alternative to the established approach to these complex lesions (medical therapy or surgery). The high incidence of CTO requires good clinical judgment in the selection of the lesions in need of recanalization. Further technical development is needed to facilitate and simplify the revascularization techniques, making them both safer and more standardized and predictable. Further evidence, ideally from randomized studies, of the clinical benefit of these inherently complex procedures may encourage more operators and centers to engage in this challenging endeavor.

Conflict of interest

The authors declare no conflict of interest related to this manuscript.

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