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Individualised treatment and novel technology to improve patient outcomes in complex percutaneous coronary intervention

Background

Percutaneous coronary interventions (PCI) are now performed with more ease and with better success rates, due, in large, to improvements in devices. Despite all the technological advancements, there are a number of lesion and patient subsets which pose therapeutic challenges in performing the procedure safely and successfully. They include patients with diabetes mellitus, renal failure, calcified vessels, bifurcation lesions, tortuous lesions, chronic total occlusions and lesions involving small vessels.

Treatment of left main stem (LSM) disease has typically been under the domain of surgeons. The main concerns are trying to achieve positive results with PCI that will translate to good long-term outcomes when compared to bypass surgery. Technical aspects, especially when dealing with distal LMS and its bifurcation, and the types of devices used will affect outcome.

Resolute Onyx™ by Medtronic is a new workhorse drug-eluting stent built on the proven clinical performance and excellent deliverability of the Resolute Integrity Drug Eluting Stent (DES). Resolute Onyx™ features Core Wire Technology that allows the stent to have a denser core within in a cobalt alloy outer layer. This allows for thinner struts, increasing deliverability and radiopacity without compromising radial strength. It also features a new delivery system with PowerTrac™ technology to provide enhanced deliverability through challenging lesions. At the same time, it has excellent side-branch access when treating bifurcation lesions. A case is presented here to illustrate the performance of Resolute Onyx™ in complex LMS, left anterior descending (LAD) and left circumflex (LCx) artery lesions.

Case presentation

A fiercely independent 74-year-old male with coronary artery disease of 3 years presented with unstable angina 2 weeks prior to being seen (Canadian Cardiovascular Society grading of Class III). The patient had been hypertensive for the last 15 years, had dyslipdaemia for 3 years and was on haemodialysis through the internal jugular vein for management of end-stage kidney disease (ESRD). He planned to undergo surgery to fashion an arteriovenous (AV) fistula for permanent haemodialysis, but surgery was deferred due to high anaesthetic risk. The patient's left ventricular (LV) function was good. Three years prior, he underwent a coronary angiogram as a work-up for angina pectoris and was noted to have severe three-vessel disease. He refused to undergo bypass surgery and was lost to follow-up until the current episode.

A coronary angiogram with a view towards ad-hoc PCI was performed through the right femoral approach in April 2015. The iliac artery was tortuous and a 7 Fr, 45 cm long Arrow Flex® Sheath (Teleflex) successfully straightened out the vessel. The coronary angiogram findings showed heavily calcified vessels, making PCI challenging due to difficult tracking through calcified lesions. There were severe stenoses in the ostial LAD and a long lesion in the midsegment LAD artery. In the LCx, significant stenoses were noted in the ostial to proximal segments and the midsegment. The midsegment of the right coronary artery (RCA) was totally occluded. The calculated SYNTAX score was 62.

Thus, this case is considered complex as the patient presented with unstable angina and has ESRD, as well as a tortuous iliac artery, calcified vessels requiring rotablation for optimal vessel preparation, significant lesions in the distal LMS and long lesions in the mid-LAD and LCx.

There were two bifurcation lesions that needed to be addressed, namely the LAD/D2 and LMS bifurcation. There was also no support from the RCA as it was occluded.

Treatment

The decision was made to only treat the left coronary artery lesions. The RCA chronic total occlusion appeared difficult and we had only one chance to perform the intervention, since the patient was unlikely to come back for further procedures.

The left coronary system was treated first. Sequential rotational atherectomy with a 1.5 mm Burr over a Rota-floppy wire was performed firstly to the LAD and then to the LCx artery at 190,000 rpm. The procedure was relatively straightforward. We then wired into the LAD (HI-TORQUE BALANCE MIDDLEWEIGHT, Abbott Vascular), followed by the diagonal branch (ASAHI SION Blue) and the LCx (Runthrough® NS Extra Floppy, Terumo). Predilatation was made with a NC Euphora (Medtronic) 2.5 x 15 mm at 20 Atm with full balloon dilatation.

We then chose Resolute Onyx™ as the stent of choice based on our personal experience with the previous generation Resolute Integrity stents. They are highly deliverable, conformable and have good side-branch access. The visibility is also good, especially when implanting in calcified vessels and planning for overlapping stents, as in this case. Based on pooled retrospective analysis of second generation Resolute zotarolimus eluting stents, Resolut Onyx™ may have the same potential of being safe if dual anti-platelet therapy (DAPT) is interrupted after 1 month, especially since compliance is suspect in this patient.[1]

The first of five Resolute Onyx™ stents was a 2.75 x 38 mm stent applied to the mid LAD, placed proximal to the second diagonal branch. It was deployed initially at 12 Atm and then went up to 18 Atm (figure 1). The second stent (3.0 x 38 mm) was deployed at 20 Atm, overlapping the distal stent into the proximal LAD across the second diagonal branch. The overlapping site was clearly seen. A kissing balloon technique was performed as the ostial diagonal was severely stenosed post stenting. A 3.5mm NC Euphora balloon in the proximal LAD, and 2.0 mm balloon at the diagonal branch were both inflated at 6 Atm.

The LCx artery was treated next, with lesions predilated with a 2.5 mm balloon. At the midsegment, the third Resolute Onyx™ stent (3.0 x 26 mm) was deployed at 18 Atm. The LMS into LAD artery had a Resolute Onyx™ 3.5 x 22 mm stent deployed from the ostial LMS overlapping with the proximal LAD stent. It was deployed at 24 Atm (figure 2). A new guidewire (Pilot 50) was used to cross the LMS stent struts before removing the LCx wire. The stent struts were opened with a 2.0 x 15 mm balloon. The fifth Resolute Onyx™ stent (3.5 x 26 mm) was then passed through the struts easily down the LCx and deployed at 16 and 20 Atm using a T-stenting and small protrusion technique (TAP). A final kissing balloon, using the 3.5 mm stent balloon in the LCx and a 3.5 mm balloon in the LAD, was inflated to 14 Atm each (figure 3).

The final angiographic results were good with TIMI 3 flow. Optical coherence tomography (OCT) was used to evaluate the final results. The stents were all well expanded and opposed to the wall despite the degree of calcification. The cross sectional area was 10.3 mm^2 for the ostial LAD, 7.8 mm^2 for the

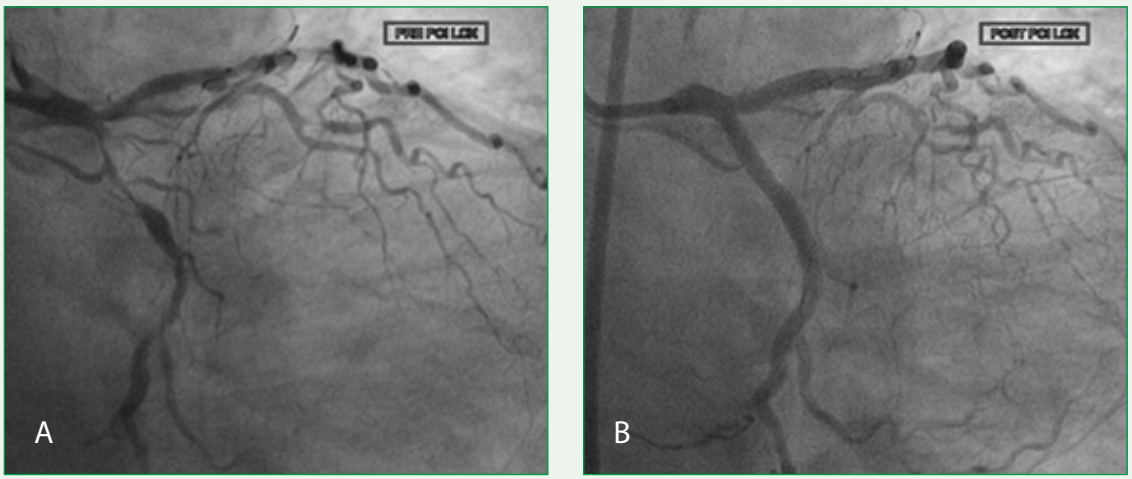

fig. 1

(A) The distal LMS, ostia of both LAD and LCx, proximal-LCx and mid-LCx stenosis.

(B) Post-PCI with Resolute Onyx™, deployed in LMS (3.5 x 22 mm) and both LAD (3.0 x 38 mm) and LCx (3.5 x 26 mm and 3.0 x 26 mm).

fig. 2

(A) Long stenosis in the proximal- to mid-LAD involving the ostium of second diagonal branch.

(B) Resolut Onyx™ stents deployed from proximal- (3.0 x 38 mm) to mid-LAD (2.75 x 38 mm).

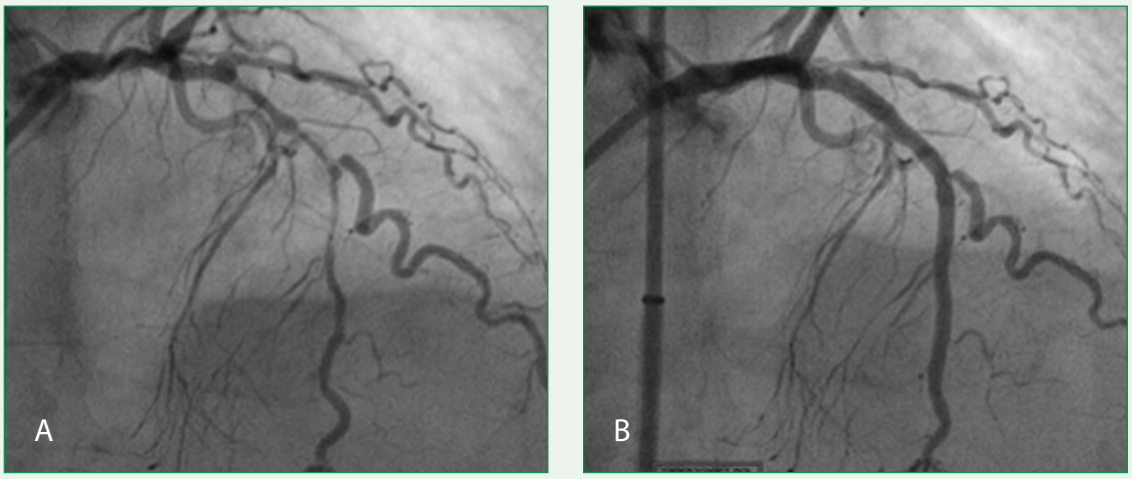

fig. 3

Final Kissing Inflation LMS (3.5 mm balloon) and LCx (3.5 mm balloon) at 14 Atm following the TAP Technique (LMS into LAD and LCx).

ostial LCx and 19.0 mm^2 for the distal LMS. The total fluoroscopy time was 39.1 minutes, total contrast used 280 ml and radiation dose was 4496 mGy. The total procedural time from diagnostic angiogram to the end of PCI was 3.5 hours.

The patient had transient dyspnoea post-procedure, which improved after undergoing haemodialysis. There was a creatinine kinase leak at five times the upper limit of normal, but there were no new electrocardiogram changes. He was discharged well 5 days post-PCI. He underwent two AV fistula surgeries over a period of 6 months and is currently on regular haemodialysis. DAPT was stopped after 8 months post-PCI by himself and he has been well for 16 months post-indexed procedure.

Take-home messages

1. Complex lesion and patient subsets are now more readily amenable to PCI with the current experience and devices.
2. Proper planning is crucial to ensure the procedure is smooth and safe.
3. Lesion preparation is very important to ensure stents are easily delivered to the lesion and expanded well, such as in this case, where rotablator and high-pressure balloon dilatation pre-stent deployment were performed.
4. Resolute Onyx™ was easily delivered to lesion sites and went through the stent struts easily. The stent balloon could go up to a very high pressure. Resolute Onyx™ could be considered routinely when dealing with complex cases.
5. OCT as one of the imaging modality is useful and important to ensure good PCI results, especially when treating LMS lesions.
6. In this group of patients, DAPT should be given for at least 1 year. However, this patient in this case study stopped DAPT by himself without any untoward complications.

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