

1046 **When rotational atherectomy is not enough: IVUS-guided escalation to intravascular lithotripsy enables stentless drug-coated balloon PCI in diffuse heavily calcified coronary artery disease**

Ahmad Faisal Badaruddin¹

HAFIDZ ABD HADI¹

¹ CARDIOLOGY DEPARTMENT, Institut Jantung Negara, Malaysia

Clinical Presentation

A 73-year-old gentleman, semi-dependent in activities of daily living and ambulatory with a walking stick, was referred from a district hospital with non-ST-elevation myocardial infarction (NSTEMI) complicated by acute decompensated heart failure.

His cardiovascular risk factors included diabetes mellitus, hypertension, and end-stage renal disease requiring maintenance haemodialysis since 2023 via a right internal jugular tunnelled dialysis catheter. He was an ex-smoker and had a previous history of a closed left acetabular and femoral fracture in October 2023.

The patient initially became acutely dyspnoeic during a haemodialysis session and was noted to have oxygen desaturation to 88% on room air. On examination, his blood pressure was 150/85 mmHg, with bilateral basal lung crepitations consistent with pulmonary congestion.

Laboratory investigations demonstrated an elevated cardiac troponin I level of 2.60 ng/mL.

Electrocardiography showed sinus rhythm with ST-segment depression in the inferior leads (II, III and aVF) and lateral leads (I, V5 and V6), consistent with diffuse subendocardial ischaemia.

Transthoracic echocardiography demonstrated severe left ventricular systolic dysfunction with a biplane left ventricular ejection fraction of 29%, accompanied by hypokinesia of the basal and mid-inferior wall segments.

Coronary Angiography

Coronary angiography revealed a short left main stem with mild atherosclerotic disease. There were severe stenoses involving the proximal and mid segments of the left anterior descending artery (LAD), the ostial and mid segments of the left circumflex artery (LCX), and the mid segment of the right coronary artery (RCA), consistent with severe diffuse triple-vessel coronary artery disease.

Given the patient's severe left ventricular dysfunction, end-stage renal disease on haemodialysis, diffuse heavily calcified multivessel coronary artery disease, and anticipated procedural complexity, a staged high-risk percutaneous coronary intervention (PCI) strategy supported by an intra-aortic balloon pump (IABP) and guided by intravascular ultrasound (IVUS) was planned. The right coronary artery was selected as the initial target for revascularisation, followed by staged intervention of the left circumflex artery.

Stage 1: High-Risk PCI of the Right Coronary Artery

Haemodynamic support was established with an intra-aortic balloon pump inserted via the left femoral artery.

The RCA was engaged using a 7 Fr JR3.5 guiding catheter and crossed with a Runthrough Floppy guidewire. Following initial predilatation with a 2.0 × 15 mm scoring balloon, IVUS demonstrated severe circumferential (360°) eruptive calcification throughout the target lesion with reference vessel diameters of approximately 3.5 mm distally and 4.5 mm proximally.

Rotational atherectomy was performed using sequential 1.5 mm and 2.0 mm Rotapro burrs. Repeat IVUS, however, demonstrated persistent circumferential calcification with limited plaque modification despite atherectomy.

Further lesion preparation was therefore performed using a non-compliant balloon followed by a 4.0 mm cutting balloon to optimise calcium modification. After satisfactory balloon expansion, sequential drug-coated balloon angioplasty was performed from the distal RCA to the ostium using Essential Pro drug-coated balloons.

Final angiography demonstrated TIMI 3 flow without flow-limiting dissection, significant recoil, or the need for bailout stent implantation.

Stage 2: High-Risk PCI of the Left Circumflex Artery

At the staged procedure, repeat angiography confirmed a widely patent RCA with preserved TIMI 3 flow.

PCI of the LCX was initially attempted via the right radial artery. However, engagement proved difficult despite multiple guiding catheter configurations, and significant radial artery spasm necessitated conversion to a left femoral approach while maintaining intra-aortic balloon pump support through the right femoral artery.

The LCX was successfully engaged with a JL4 7 Fr guiding catheter. Although the lesion was crossed with a Runthrough Floppy guidewire, advancement of a Caravel microcatheter was unsuccessful. Escalation to a Turnpike Spiral microcatheter and subsequently a Grandslam guidewire also failed because of the severe proximal calcification. An extra-support guidewire ultimately facilitated device delivery.

Rotational atherectomy was performed using a 1.5 mm burr with multiple runs at 200,000 rpm. Subsequent IVUS demonstrated persistent circumferential (360°) ring calcification with only minimal calcium modification and a minimal lumen area of 2.1 mm².

Given the inadequate plaque modification, intravascular lithotripsy was performed using a 3.0 × 12 mm LIQMAGIC balloon with delivery of 50 pulses. Additional lesion preparation with a non-compliant balloon and cutting balloon was subsequently undertaken. Repeat IVUS demonstrated satisfactory calcium fracture, improved lumen expansion, and adequate lesion preparation.

Following confirmation of optimal vessel preparation, the lesion was treated with sequential RESTORE drug-coated balloons without stent implantation.

Final angiography demonstrated an excellent angiographic result with TIMI 3 flow, no significant residual stenosis, no flow-limiting dissection, and no requirement for bailout stenting.

Discussion

This case demonstrates the importance of using intravascular imaging to guide the treatment of diffuse, heavily calcified coronary artery disease. Although rotational atherectomy allowed the devices to cross the lesion, repeat IVUS showed that the calcium was still not adequately treated because a thick ring of calcium remained. Based on these findings, the procedure was changed to include intravascular lithotripsy before proceeding with the final treatment.

The combination of rotational atherectomy, intravascular lithotripsy, specialised balloon angioplasty, and IVUS guidance achieved good calcium modification and allowed successful treatment with a drug-coated balloon alone, without the need for long coronary stents.

This case also shows that rotational atherectomy and intravascular lithotripsy work well together rather than replacing one another. IVUS plays an important role in assessing the result of calcium modification and helps determine when additional treatment is needed. In selected patients with diffuse, heavily calcified coronary artery disease, this approach may allow successful stentless PCI while maintaining a good procedural outcome.