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A calcific, undilatable stenosis;
Lithoplasty – a new tool in the box?

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A 69-year-old gentleman with established coronary artery disease and LV dysfunction (EF 40%) with typical CCS class 3 angina underwent PCI for severe diffuse calcific disease in the RCA (Fig 1). The vessel was prepared with 2.5mm and 3.0mm balloon pre-dilatation. However, despite the use of 3.0mm non-compliant balloon there was inadequate balloon expansion with a 'dog-bone' appearance observed (Fig 2). The patient was readmitted for a further attempt at PCI with adjunctive lithoplasty for calcium debulking. A 3.5x12mm Lithoplasty balloon (Shockwave Medical) was the initial and only balloon used to pre-dilate and treat the entire length of disease. Briefly, the Lithoplasty technique involves inflating the balloon to low pressure (4atm) with eight, 10-second pulses of ultrasound energy delivered per balloon. A degree of balloon deformation was observed secondary to a region of lesion constriction, at the nominal pressure of 4atm, the Lithoplasty was initiated, with the balloon seen to inflate fully at this low pressure (Movie 1). The balloon is then inflated to 6atm for 15-20 seconds after each pulse, to maximise balloon expansion and aid removal of debris. Lithoplasty preferentially allows calcium modification without affecting the endovascular soft tissue, and subsequently aids stent delivery and optimisation. OCT performed pre and post-lithoplasty showed the calcium 'cracking' effect of the technique (Fig 3). The segment of disease was then treated with a 3.5x22 and 4.0x16mm DES with a good OCT (Fig 4) and angiographic (Fig 5 & Movie 2) result.

Calcific coronary disease remains an important cause of stent under expansion and represents a nidus for stent thrombosis. Revascularization undertaken in those of > 75 years, a cohort with increased coronary calcification, now accounts for 25-30% of all PCI procedures.[1] Current techniques to modify calcific stenoses include, standard or high-pressure non-compliant balloons, cutting/scoring balloons or rotational atherectomy. High pressure balloon treatment may lead to localized wall injury, which may provide a vascular substrate for restenosis, with this and rotational atherectomy also increasing the risk of coronary perforation (0.7% with rotational atherectomy versus 0.1% in standard procedures).[2] Lithoplasty may provide an adjunct to PCI that provides focal calcium modification with limited localized injury to the endovascular surface whilst aiding stent delivery and expansion.

References:

[1]Vandermolen S, Abbott J, De Silva K. What's Age Got to Do with it? A Review of Contemporary Revascualrization in the Elderly. Curr Cardiol Rev. 2015;11(3):199-208.

[2]Cohen BM< Weber VJ, Reslman M, Casale A, Dorros G. Coronary perforation complicating rotational atherectomy: the U.S. Multicenter experience. Cathet Cardiovasc Diag, 1996;Suppl 3:55-9.

Figures

Figure 1: Pre-PCI Angiogram

Figure 2: 'Dog-bone' of non-compliant balloon

Figure 3: OCT showing 'calcium cracking' following Lithoplasty

Figure 4: Co-registered angiogram/OCT result post PCI

Figure 5: Final angiographic appearance

Movie 1: Zoomed view of Shockwave balloon at 4atm during Lithotripsy pulse

Movie 2: OCT imaging post PCI; Short-axis and Longitudinal views with rendered stent and intra-coronary 'fly-through'