

**CASE REPORT**

Intravascular lithotripsy assisted chronic total occlusion revascularization with reverse controlled antegrade retrograde tracking

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Abstract

Advances in percutaneous coronary intervention (PCI) techniques in chronic total occlusion (CTO) procedures have improved the success of this procedure. CTO PCI via the retrograde approach are facilitated most frequently by reverse controlled antegrade/retrograde tracking (R-CART). This aims to create a communication between the proximal and distal lumens, which may be achieved between intimal and subintimal spaces. In patients with calcified coronary vessels, creating sufficient disruptions to connect these spaces can be challenging. Intravascular lithotripsy (IVL) has become a useful tool to modify intracoronary calcification for stent deployment and expansion. This case demonstrates the utility of IVL in facilitating connection in R-CART to complete the CTO PCI where heavy calcification was present at the site of chronic occlusion.

KEYWORDS

chronic total occlusion, coronary artery disease, intravascular ultrasound imaging, percutaneous coronary intervention, stenting technique

1 | INTRODUCTION

Percutaneous coronary intervention (PCI) of chronic total occlusions (CTO) is a rapidly evolving field. Subintimal dissection/re-entry techniques have increased and the success of these procedures has improved with the development of specialized equipment.¹ However, coronary calcification continues to create challenges particularly when undertaking dissection/re-entry at sites where there is heavy calcification. This case demonstrates the utility of intravascular lithotripsy (IVL) in facilitating reverse controlled antegrade/retrograde tracking (R-CART) where heavy calcification was present at the site of chronic occlusion.

2 | CASE REPORT

An 81-year-old female with a history of hypertension and diabetes presents for coronary angiography in the setting typical Canadian Cardiovascular Society class III angina. Coronary angiography demonstrated a heavily calcified right coronary artery (RCA) CTO (Figure 1,

panel A, Movie I) with Rentrop grade III collaterals from the left system (Figure 1, panel B, Movie II). Cardiac magnetic resonance imaging demonstrated preserved LV systolic function and inducible inferior territory ischemia. She was scheduled for RCA CTO PCI with an initial strategy of R-CART. A Mamba Flex (Boston Scientific, Marlborough, MA) microcatheter and a Sion Black wire (Asahi Intecc, Nagoya, Aichi, Japan) was passed to the distal cap of the RCA CTO via epicardial collaterals from the obtuse marginal branch of the circumflex coronary artery. A retrograde dissection plane was instigated using a looped polymer-coated wire, which was then advanced just short of the proximal occlusion. Antegrade equipment was then advanced beyond the proximal CTO cap within intimal plaque so that it was overlapping the retrograde microcatheter. Standard balloon inflation failed to create a communication due to insufficient modification of the heavy calcification and hence the retrograde guidewire failed to enter into the proximal lumen. This segment was therefore treated with IVL with delivery of 40 pulses using a 3.0 × 12 mm balloon (Shockwave Medical, Fremont, CA) inflated at low pressure (4 atms) (Figure 1, panel C, Movie III). This modified the calcium sufficiently enough to create a

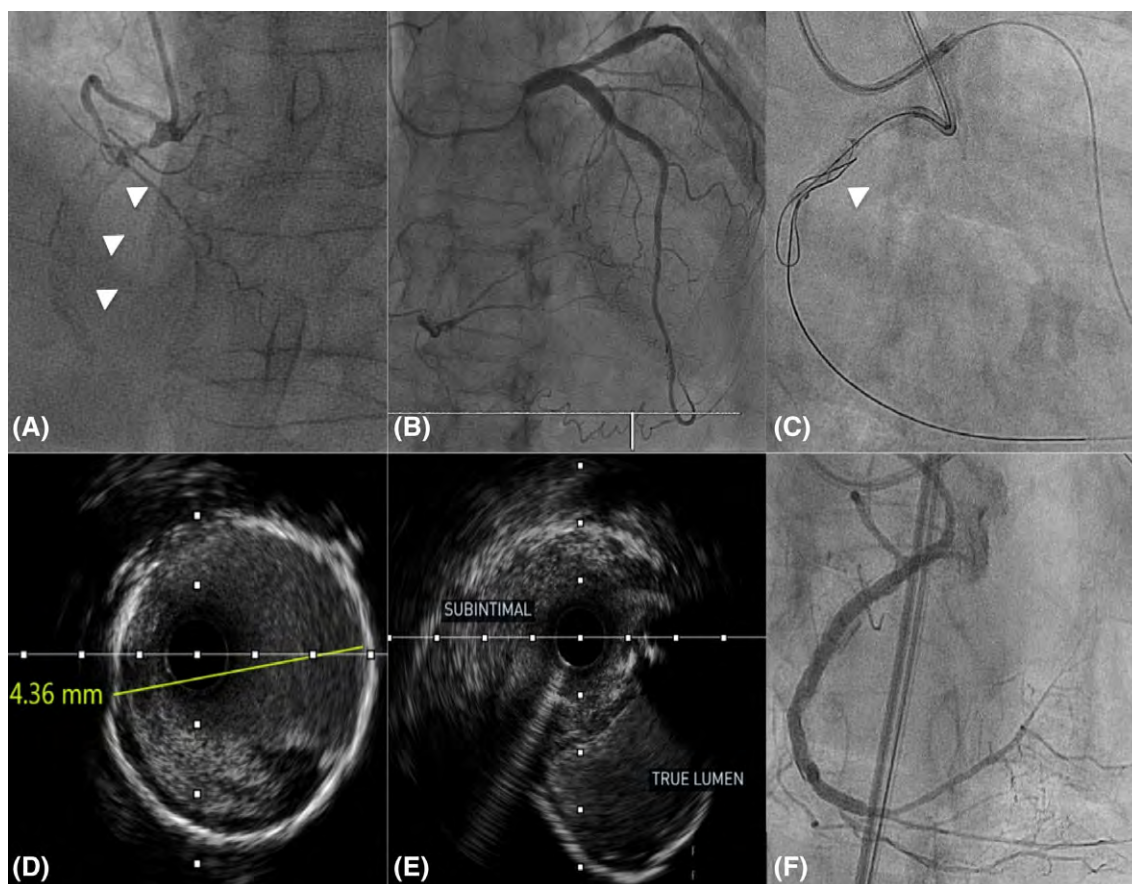


FIGURE 1 RCA CTO PCI using reverse controlled Antegrade retrograde tracking assisted by intravascular lithotripsy. Panel A, RCA CTO with heavy calcification noted (arrowheads). Panel B, Rentrop class III left to right collaterals. Panel C, Inflation of a 3.0×12 mm intravascular lithotripsy balloon at low pressure with application of 40 pulses of high-pressure sonic wave to modify calcium and allow connection (arrowheads). Panel D, IVUS demonstrating heavy calcification in the proximal RCA segment. Panel E, IVUS demonstrating the subintimal track and true lumen connection. Panel F, Final angiographic result following RCA CTO revascularization [Color figure can be viewed at wileyonlinelibrary.com]

communication between the proximal lumen and the subintimal space thereby allowing passage of the retrograde guidewire into the proximal lumen and was subsequently externalized. Intravascular ultrasound (IVUS) demonstrated severe coronary calcification (Figure 1, panel D), confirmed communication between the proximal true lumen and the distal dissection plane (Figure 1, panel E) and guided stent sizing. Revascularization was performed using sequential 2.5×28 , 3.0×28 and 4.0×16 mm platinum chromium everolimus-eluting stents that were post dilated with both 3.0 and 4.0 mm non-compliant balloons. Final angiographic and IVUS imaging demonstrated an excellent result (Figure 1, panel F, Movie IV).

3 | DISCUSSION

The presence of coronary calcification can make coronary revascularization problematic with difficulty passing intracoronary devices and inhibiting stent expansion.² The techniques available for CTO crossing can be either antegrade or retrograde and in either direction, crossing can be achieved either from true-to-true lumen or by first entering the subintimal space, followed by re-entry into the true lumen (dissection/re-entry strategies).³ For this to be achieved, medial tears are

created by balloon expansion causing a communication between intimal and subintimal planes. However, in the setting of heavy coronary artery calcification, conventional balloon expansion may be insufficient to modify the plaque. In this scenario, IVL has considerable promise. IVL has been shown to be a safe tool for the application into calcified coronary arteries to allow stent delivery and stent expansion.⁴ In the setting of heavy coronary calcification, IVL creates multiple intra-plaque fractures that may be able to modify calcified intimal tissue sufficiently to facilitate connection between intimal and subintimal tissue planes.

4 | CONCLUSION

Coronary calcification can make PCI challenging particularly when undertaking CTO intervention. Intravascular lithotripsy has become a useful tool to modify coronary calcification. This case demonstrates the utility of IVL to assist in controlled antegrade/retrograde tracking.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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REFERENCES

1. Wilson WM, Walsh SJ, Yan AT, et al. Hybrid approach improves success of chronic total occlusion angioplasty. *Heart*. 2016;102:1486-1493.
2. Bourantas CV, Zhang YJ, Garg S, et al. Prognostic implications of coronary calcification in patients with obstructive coronary artery disease treated by percutaneous coronary intervention: A patient-level pooled analysis of 7 contemporary stent trials. *Heart*. 2014;100:1158-1164.
3. Spratt JC, Strange JW. Retrograde procedural planning, skills development, and how to set up a base of operations. *Interv Cardiol Clin*. 2012; 1:325-338.

4. Ali ZA, Brinton TJ, Hill JM, et al. Optical coherence tomography characterization of coronary lithoplasty for treatment of calcified lesions: First description. *JACC Cardiovasc Imaging*. 2017; 10:897-906.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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