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CASE REPORT

ADVANCED

CLINICAL CASE

Transcoronary Rapid Pacing Solving a Complex Retrograde Chronic Total Occlusion Procedure

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ABSTRACT

We report a case of revascularization of the right coronary artery via the epicardial collateral, for which we used transcoronary rapid pacing to obtain cardiac standstill while puncturing the distal chronic total occlusion (CTO) cap. To our knowledge, this is the first case in which this technique has been used in CTO. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2019;1:832–7) © 2019 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

We report the case of a 70-year-old patient who was admitted to our institute for revascularization of a right coronary artery (RCA) chronic total occlusion (CTO). He presented with class 3 angina and a large area of inferolateral ischemia confirmed on myocardial perfusion imaging (single-photon emission computed tomography).

PAST MEDICAL HISTORY

The patient's cardiovascular risk factors were a past history of smoking and a family history of coronary artery disease.

LEARNING OBJECTIVES

- To identify the problem and danger of puncturing moving CTO cap.
- To overcome the problem by using transcoronary rapid pacing to obtain cardiac standstill.

DIFFERENTIAL DIAGNOSIS

The case we report concerns a scheduled CTO procedure for which a differential diagnosis such as chronic heart failure or pulmonary embolism was excluded before hospitalization.

INVESTIGATIONS

On angiography, the mid-RCA presented as a 20-mm-long calcified stenosis and a 30-mm-long CTO of the distal RCA. This CTO was calcified, and the distal cap was located at the crux bifurcation (**Figure 1**). The distal bed was mainly filled by an epicardial collateral from the first diagonal. The J-CTO (Multicenter CTO Registry of Japan) score was 3 (length, calcium, retry). An initial antegrade attempt performed at a peripheral center 1 year earlier was unsuccessful.

MANAGEMENT

To provide optimal comfort for the patient, we used an approach via the left dorsal radial artery (**Figure 2C**) to reduce wrist rotation, in conjunction with the

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Informed consent was obtained for this case.

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STARBoard system (Adept Medical Ltd., Morningside, Auckland New Zealand) (**Figure 2D**). To relieve the patient's significant anxiety, we opted for a new virtual reality Google system from DEEPSEN (Saint Didier au mont d'or, France) (**Figure 2B**), which involves a cardiac coherence algorithm and a 360° cinema screen. The patient received a loading dose of clopidogrel (600 mg) and aspirin (160 mg) the day before the CTO procedure. A heparin bolus (100 IU/kg) was administered, with a control of the activated clotting time every 20 min. Using a bilateral radial approach (**Figure 2A**), a 7-F AL 0.75 guiding catheter (Cordis Vista Brite) with a 7-F Railway sheathless system (Cordis, Santa Clara, California) and an XB 3.5 guiding catheter (Cordis Vista Brite, Santa Clara, California) were seated in the coronaries. A 7-F TrapLiner catheter (Teleflex, Morrisville, North Carolina) was placed in the proximal RCA over a workhorse guidewire in a right ventricular branch. After a short unsuccessful antegrade approach, a retrograde approach was swiftly adopted according to the hybrid algorithm (1), via the epicardial collateral circulation, because a tortuous septal collateral was noninterventional.

The main technical problem encountered was the difficulty of epicardial collateral wire crossing. After guidewire escalation (Sion and Sion Black, Asahi Intecc, Aichi, Japan), epicardial crossing was achieved with an Asahi Suoh 3 guidewire (Asahi Intecc). After the microcatheter (Caravel, Asahi Intecc) was advanced to the RCA, an intense back-and-forth motion of the microcatheter with the cardiac cycle became apparent. This motion created considerable jeopardy during attempted puncture of the distal cap (Fielder XT-A, Asahi Intecc), where the guidewire was out of control. There was considerable risk that this tapered guidewire would pass outside of the vessel architecture during cardiac contraction (**Figure 3**, Video 1).

To safely perform distal cap puncture, we switched to a stiffer guidewire (Gaia Third, Asahi Intecc) and used the transcoronary pacing technique (2) to obtain cardiac standstill while puncturing and entering into the distal CTO cap. To achieve pacing, we placed the cathode of an alligator clamp on the body of the Asahi Sion Blue guidewire at its exit from the guiding catheter seated in the RCA and attached the other clamp (anode) to a subcutaneous needle in the anesthetized right wrist (**Figure 4**). A Medtronic 5388 external pacemaker (Minneapolis, Minnesota) was connected to the alligator clamps, and 10-mA power (pulse width 1.5 ms) was pulsed at 180 beats/min with 1:1 capture for 20 s. During cardiac standstill, safe and efficient distal cap puncture was achieved. After the guidewire was advance 15 mm into the occlusion segment, rapid pacing was discontinued, and the microcatheter was passed into the lesion in the usual fashion.

A retrograde dissection re-entry technique was required to cross the lesion (GuideLiner-assisted reverse controlled antegrade and retrograde tracking, Teleflex). This was achieved using a retrograde Gaia Third guidewire, which was then anchored in the TrapLiner in order to advance it through the body of the CTO and in the guide extension (**Figure 5**). An RG3 guidewire (Asahi Intecc) was externalized. Both branches were secured distally using a dual-lumen catheter (Fine-Duo, Terumo, Tokyo, Japan), and a workhorse wire was placed in the posterolateral branch of the RCA. After pre-dilatation of the main vessel, 142 mm of overlapping biodegradable polymer drug-eluting stents (Ultimaster Tansei, Terumo) was deployed from the ostial RCA to the proximal posterior descending artery. A kissing balloon inflation and a proximal optimization technique were performed in the distal RCA bifurcation. The final result was excellent (**Figure 6**). Optical coherence tomography analysis was performed to assess apposition and expansion of the stents.

ABBREVIATIONS AND ACRONYMS

CTO = chronic total occlusion

PCI = percutaneous coronary intervention

RCA = right coronary artery

DISCUSSION

Management of coronary CTO requires considerable expertise (3). The main benefit of our case is that it will provoke discussion of the potential role of rapid pacing via a coronary guidewire in CTO procedures and in interventional cardiology more broadly. In addition, to our knowledge this case is the first description of the technique used in the area of CTO.

FIGURE 1 Baseline Angiogram

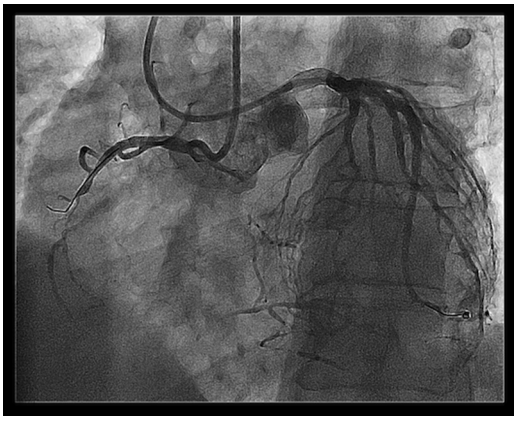

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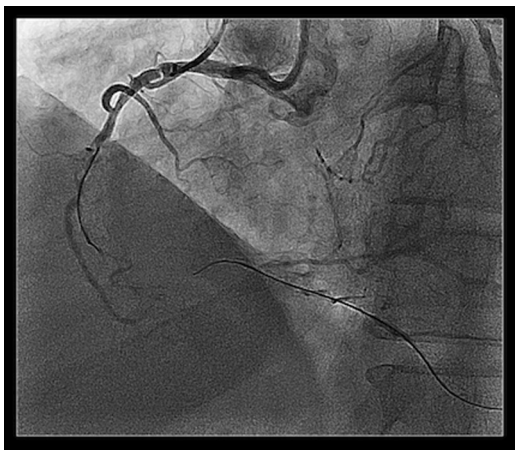
FIGURE 2 Modern Setup for Chronic Total Occlusion Percutaneous Coronary Intervention

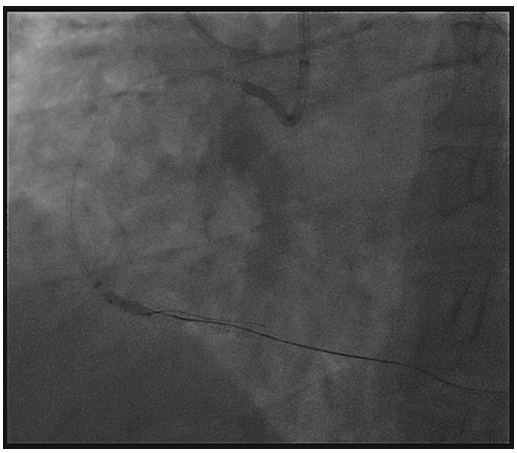
(A) Bilateral radial approach with left dorsal radial lateral approach. **(B and C)** Distal dorsal radial approach with sheathless guiding catheter. **(D)** Starboard system for radial approach.

FIGURE 3 Retrograde Fielder XT-A



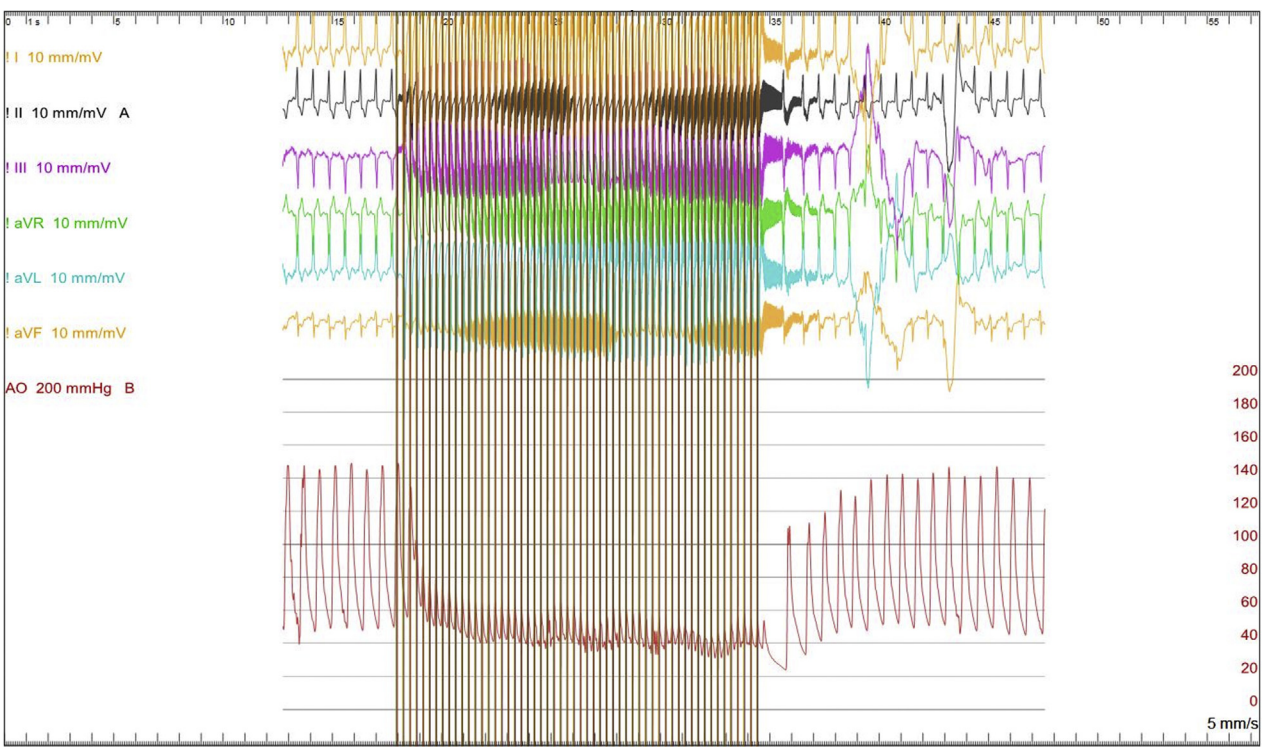
Video of retrograde Fielder XT-A guidewire moving backward and forward outside the vessel architecture with each heartbeat. See Video 1.

FIGURE 5 TrapLiner-Assisted Reverse Controlled Antegrade and Retrograde Tracking, and Reverse Trapping Balloon



Transcoronary pacing was first described by Meier and Rutishauser (2) in 1985 and has been further developed by our team in recent years for structural heart interventions (4). One benefit of this technique is that it enables pacing that is effective and safe for the patient while avoiding implantation of an additional transvenous right ventricular pacing lead and its potential complications (5). Moreover, transcoronary pacing via a guidewire provides quick and

FIGURE 4 Transcoronary Wire Pacing Technique to Stabilize Distal Cap Puncture



Electrocardiogram and hemodynamic curves recording of transcoronary wire pacing technique to stabilize distal cap puncture.

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FIGURE 6 Final Angiogram

effective pacing that is easy to set up. With this technique, cardiac pacing is obtained by delivering electric current directly via the 0.014-inch angioplasty guidewire. In practice, this technique simply involves connecting the black clip (cathode) to the 0.014-inch guidewire and the red clip (anode) to a needle placed in the subcutaneous tissue. The external cardiac pacemaker remains the same.

This direct wire pacing technique is also being used by several teams performing transcatheter aortic valve implantation (4,6). In addition, our team has participated in a multicenter, randomized trial comparing pacing via a guidewire versus implantation of a transvenous right ventricular pacing lead. The study showed significant reduction of procedural time, fluoroscopy time, and hospital costs but maintained safety and efficacy (7). There are many possible indications for pacing via a coronary guidewire in interventional cardiology. The primary indication is emergence of complete atrioventricular block during the procedure, but we believe that transcoronary rapid pacing can also be potentially beneficial during stent positioning for ostial lesions if significant cardiac movement is present.

FIGURE 7 Malapposition Optical Coherence Tomography

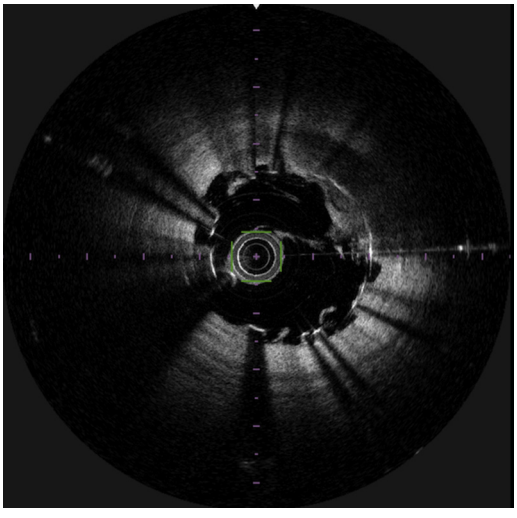
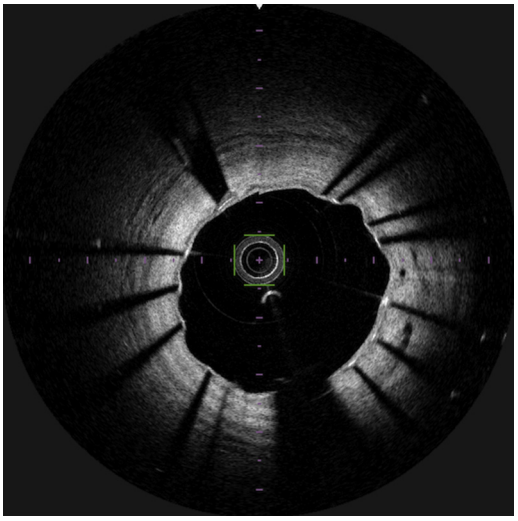


FIGURE 8 Final Optical Coherence Tomography



FOLLOW-UP

The patient was reviewed at 3 months and found to have no further angina. Early follow-up coronary angiography was performed as part of the patient's participation in a study. Optical coherence tomographic imaging demonstrated focal stent malapposition (**Figure 7**) in the mid and distal segments that was treated using semicompliant balloon (Sapphire II PRO 4/15 mm, Orbus Neich, Shatin NT, Hong Kong) dilation, after which complete stent apposition was achieved (**Figure 8**).

CONCLUSIONS

Our case is a reminder of the possibility of using transcoronary rapid pacing via a coronary angioplasty guidewire and, to the best of our knowledge, is the first such case involving CTO revascularization. This technique provided transient cardiac standstill and facilitated safe puncturing of the distal CTO cap after

a retrograde approach via the epicardial collateral circulation and more generally for puncturing moving CTO caps.

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KEY WORDS chronic total occlusion, percutaneous coronary intervention, rapid pacing

APPENDIX For a supplemental video, please see the online version of this paper.