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## Case Report

# Challenges in coronary CTO intervention after TAVR: A case report and discussion

Shishir Murarka<sup>a</sup>, Ashish Pershad<sup>b,\*</sup><sup>a</sup> Cardiology Fellow, Banner University Medical Center, Phoenix, AZ, USA<sup>b</sup> Director of Interventional Cardiology Fellowship, Banner University Medical Center, Phoenix, AZ, USA

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## ABSTRACT

Progression of coronary arteries after transcatheter aortic valve replacement is an important issue. Coronary revascularization in these patients can be challenging because of potential hindrance posed by the artificial valve structure in getting access to the coronary ostium. This gets even more difficult in chronic total occlusions (CTOs) that represent the most complex subset of coronary lesions. We report the first case of coronary CTO revascularization in a patient who underwent TAVR a few months prior and discuss the complexities involved in intervening such lesions.

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## 1. Introduction

More than 50,000 transcatheter aortic valve replacement (TAVR) procedures have been performed worldwide and the numbers are expected to increase. There will be a need for coronary revascularization after these procedures particularly in the high- and intermediate-risk group of patients who undergo TAVR. Coronary revascularization after TAVR is challenging for a variety of reasons after implantation of self-expanding or balloon expandable valves. Chronic total occlusion (CTO) percutaneous coronary intervention (PCI) represents the pinnacle of complexity in coronary intervention. This case report describes the complexity and challenges of CTO PCI following a Corevalve (Medtronic Inc, MN, USA) implantation.

## 2. Case summary

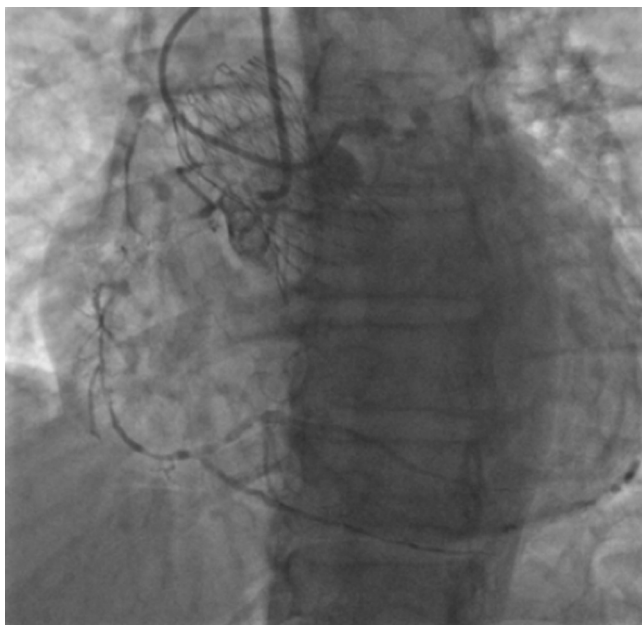
A 60-year-old male with a history of coronary artery disease, hypertension, hyperlipidemia, and severe peripheral artery disease was diagnosed with severe symptomatic aortic valve stenosis after he presented with class IV heart failure. His LVEF was 20%. His coronary angiograms demonstrated a CTO of the proximal right coronary artery (RCA) (Fig. 1) with left to right collaterals from the septal perforator branches of the left anterior descending (LAD) artery to the posterior descending artery (PDA) and 3<sup>rd</sup> Diagonal branches to the posterolateral artery (PLA). His left coronary system was free of flow limiting disease. He also underwent abdominal aortography that demonstrated an infra-renal aortic occlusion consistent with Leriche's syndrome. Due to the presence of Rentrop grade 3

\* Corresponding author at: Banner University Medical Center, 1300 N. 12th Street Suite 407 Phoenix, AZ 85006, USA. Tel.: +1 602 839 7393; fax: +1 602 839 7661.

E-mail address: [ashish.pershad@bannerhealth.com](mailto:ashish.pershad@bannerhealth.com) (A. Pershad).

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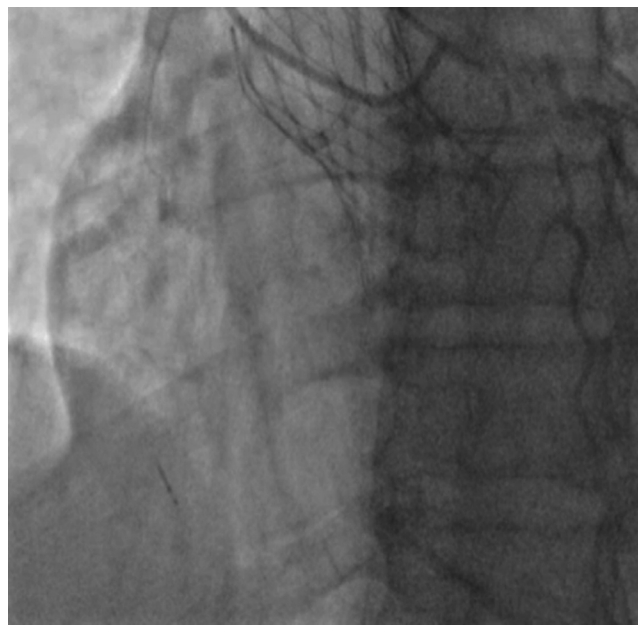
**Fig. 1 - Bilateral injection demonstrating long RCA CTO with non-ambiguous proximal cap and good landing zone for reentry.**

collaterals and absence of angina, nuclear imaging or revascularization of the RCA CTO was deferred prior to TAVR. His symptoms and LV dysfunction were attributed to the severe aortic valve stenosis.

Based on his STS score, he was deemed a high risk for traditional surgical aortic valve replacement (SAVR) and underwent TAVR successfully via direct aortic approach with a 31 mm Corevalve (Medtronic Inc, MN, USA). He had an uncomplicated hospital course of 7 days and was discharged home.

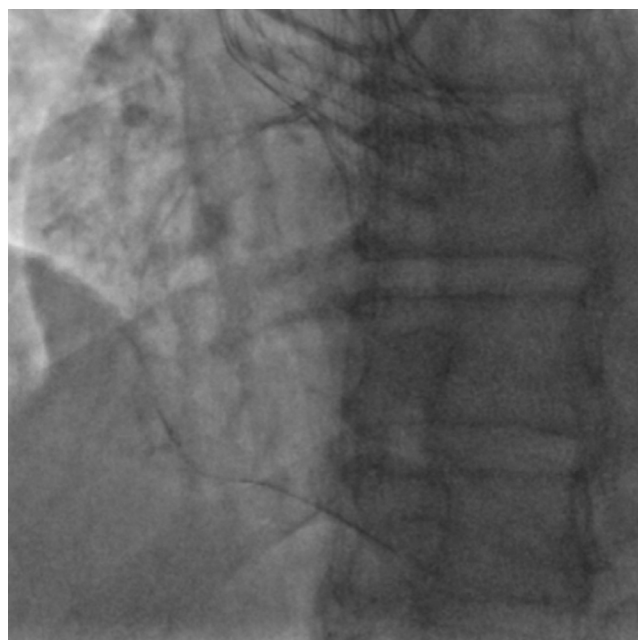
At 2-month outpatient follow-up, his dyspnea had improved but he was now complaining of Class II angina and was found to have an abnormal pharmacological stress test with inferior wall ischemia and an ejection fraction of 35%. A clinical decision was made to revascularize the CTO of the right coronary artery.

Due to the presence of an infra-renal aortic occlusion, the procedure was planned with the intent to use bilateral upper extremity access. Contralateral access was obtained with a 90 cm 6Fr JL 4 from the left radial artery for retrograde visualization of collaterals. An EBU (Medtronic, Inc., Minneapolis, MN) shape was unable to engage the left main as it was caught on the stent frame of the Corevalve (Medtronic Inc, MN, USA). Antegrade access was performed with a 7Fr JR 4 catheter from the right brachial artery. It was felt by the operators that the right radial artery was not large enough to accommodate a 7Fr sheath and there was no availability of sheathless guiding catheters. There was difficulty in engaging the RCA ostium with the JR 4 catheter. It continued to get caught on the struts of the Corevalve (Medtronic Inc, MN, USA), and, hence it was switched out for an AL-0.75 and then a MP-1 catheter. Both these catheters had identical issues with inter-action with the Corevalve (Medtronic Inc, MN, USA) prosthesis. Attempts were even made to wire the RCA from the cusp of the RCA through the struts of the Corevalve (Medtronic Inc, MN, USA) but were

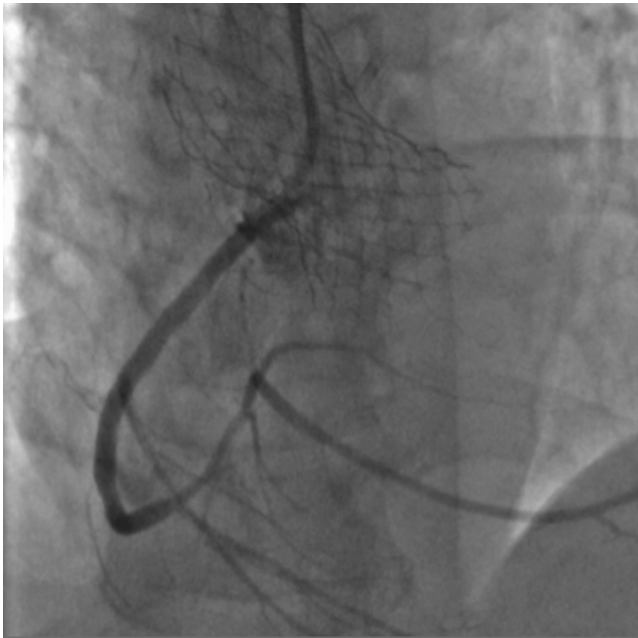


**Fig. 2 - Successful reentry to the true lumen with Stingray catheter.**

unsuccessful. Finally, a LIMA catheter was successful in engaging the RCA ostium but the orientation was non-coaxial. A Corsair catheter (Asahi Intecc, Nagoya, Japan) was advanced up to the proximal cap of the RCA CTO with the support of a Whisper wire (Abbott Vascular, CA, USA). Antegrade dissection with a Pilot 200 wire (Abbott Vascular, CA, USA) was performed. The Stingray catheter (Boston Scientific, MA, USA) was then advanced within the subintimal space to the reentry zone and successful reentry to the true lumen was achieved with a StingRay wire (Boston Scientific, MA, USA) (Figs. 2 and 3). The Pilot 200 wire (Abbott Vascular, CA, USA)



**Fig. 3 - Stingray wire across the lesion.**



**Fig. 4 – Final angiographic results with a TIMI III flow.**

was then used to perform a “stick and swap” maneuver. Antegrade PCI was then performed with deployment of 3 drug eluting stent (DES) (Fig. 4).

Once the procedure was complete, a TR (Terumo Medical, Somerset NJ) band was placed to the left radial artery and right brachial artery with successful hemostasis. There were no post-procedural complications and the patient was discharged home the next day after overnight observation. His angina has resolved and on follow-up echocardiography his ejection fraction has normalized.

### 3. Discussion

Management of CAD after TAVR especially in the intermediate- and high-risk subgroup of patients remains an ongoing challenge. PCI can be challenging because of potential hindrance posed by the valve struts in getting access to coronary ostia. CTOs are the most complex subset of coronary lesions that add another level of difficulty. CTOs typically demand greater guide catheter support to be able to use specialized wires, catheters, and techniques. Co-axial guide catheter engagement of the coronaries is essential for CTO PCI. A few cases of post-TAVR intervention of non CTO coronary lesions using femoral artery access have been described<sup>1</sup>; however, this case is the first reported case of successful revascularization of a CTO using the brachial/radial artery approach in a patient after TAVR.

Coronary occlusion immediately after TAVR from leaflet impingement contained rupture; calcific plaque embolization and flow turbulence obstructing left main flow have all been described in the literature<sup>2</sup> but issues associated with cannulation of coronary arteries for managing stable CAD months or years after TAVR have not been previously described in the literature.

It is paramount to understand the three-dimensional geometry of transcatheter aortic valves as it relates to the aortic root anatomy and commissural orientation of the devices. It requires comprehension of how the valve after deployment will relate to the coronary ostia. Currently there are CT software programs in development that will allow prediction of this sort of information but they are currently in phases of validation.<sup>3</sup>

There are two types of commercially available bioprosthetic valves used for TAVR: The Sapien XT valve (Edward Lifesciences, CA, USA) and the Core valve (Medtronic, MN, USA). The Sapien XT valve uses a bovine pericardial valve mounted on a balloon expandable cobalt chromium frame. The design and height of this valve allows the valve to be implanted such that, the coronary ostia are above the valve struts. As a result, the coronary guiding catheter used to engage the coronaries does not have to negotiate the struts.

The Corevalve (Medtronic Inc, MN, USA), on the other hand, consists of a self-expanding nitinol frame with a porcine pericardial tissue valve. The frame of this valve system has a diamond- or rhomboid-shaped open cell configuration. The outflow part of the frame is above the coronary sinuses, while the inflow portion anchors in the subannular plane. The frame of this valve intentionally crosses and covers both the coronary ostia. To engage the coronary arteries the coronary guiding catheter has to traverse the stent struts as was done in this case and this can be very difficult to reliably do. The Portico (St. Jude Medical, MN Minnesota) and Evolut R version of the Medtronic Corevalve (Medtronic Inc, MN, USA) are second-generation devices with larger cells for supposed easier access into the coronaries.

Prior to PCI, aortic root angiography may be useful to evaluate the valve as well as to locate the position of the coronary ostia. In spite of the open cell design, substantial friction and interaction between the catheter and the stent frame was encountered in this case. Although the orientation of the RCA ostium from the aorta was not unusual the usual-sized JR 4 catheter had enormous challenges in navigating the stent struts from the right radial approach. Whether this might have been easier from the femoral approach or the left radial approach or with use of dedicated radial artery catheters is conjectural.<sup>4</sup> A trial and error approach of several catheters was attempted before finding success with a LIMA catheter for the RCA. Engaging the left main coronary artery with an EBU catheter was also not feasible. Reverting back to a JL4 catheter enabled access to the left main coronary artery.

The issue of coronary revascularization prior to TAVR is understudied and controversial. A comprehensive review of the available data and current literature suggests that all obstructive coronary lesions do not need to be revascularized prior to TAVR; however, PCI may be beneficial only in severe proximal stenotic lesions that puts a substantial area of myocardium at ischemic risk.<sup>5</sup> This may be even somewhat less concerning with self-expanding Corevalve (Medtronic Inc, MN, USA) as compared to balloon expandable Sapien XT valve (Edward Lifesciences, CA, USA) because it obviates the need for rapid ventricular pacing and thereby has comparatively lower risk of inducing ischemia and hemodynamic instability owing to non-revascularized coronary arteries.<sup>5</sup> In this case, because

of the presence of satisfactory left to right collaterals and the use of Corevalve for TAVR, further assessment or revascularization of RCA CTO was not performed before TAVR.

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#### 4. Conclusions

This case demonstrates that CTO PCI is feasible after TAVR but brings with it unique challenges that have not previously been encountered. Meticulous planning and understanding of the prosthetic valve geometry, spatial configuration, and its relation to the coronary ostia are essential to the success of this procedure. Future iterations of transcatheter valves and CT-guided algorithms might allow tailoring of valve choice to aortic root anatomy that would include coronary artery orientations.

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#### Conflicts of interest

The authors have none to declare.

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