JACC: CASE REPORTS VOL. 3, NO. 4, 2021

MINI-FOCUS ISSUE: CORONARY ARTERY DISEASE

ADVANCED

CASE REPORT: CLINICAL CASE

Retrograde Access to Seal a Large Coronary Vessel Balloon Perforation Without Covered Stent Implantation

Anastasios Kartas, MD, MSc, Efstratios Karagiannidis, MD, MSc, Georgios Sofidis, MD, MSc, PhD, Nikolaos Stalikas, MSc, Anastasios Barmpas, MD, MSc, Georgios Sianos, MD, PhD

ABSTRACT

The sealing of a large vessel coronary perforation during percutaneous coronary intervention typically requires the deployment of 1 or more covered stents. A novel approach to seal a life-threatening perforation caused by unnoticed wire-exit and balloon dilation, utilizing retrograde techniques, without a covered-stent is described. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:542–5) © 2021 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/).

INTRODUCTION

Coronary perforation is the Achilles' heel of chronic total occlusion (CTO) percutaneous coronary intervention. It occurs in approximately 6% of CTO procedures and is associated with a high risk for periprocedural death (1). By convention, sealing a coronary perforation requires the deployment of one or more covered-stents (CSs). In this case report, we describe a patient who underwent a complex percutaneous coronary intervention procedure, complicated by a large-vessel perforation. A retrograde approach was utilized to access and seal the perforation without the need for a CS implantation.

LEARNING OBJECTIVES

- To bear in mind a bailout technique that may allow sealing of a large vessel perforation via the retrograde approach, without need for a covered stent.
- To always employ contralateral injections, when dealing with complex, obstructive lesions with collaterals, so as to avoid vessel perforation.

HISTORY OF PRESENTATION

A 68-year-old woman presented to a peripheral hospital with angina refractory to medical treatment. The patient had previously established coronary artery disease, which consisted of proximal right coronary artery (RCA) CTO in conjunction with a severe mid-left anterior descending coronary artery (LAD) stenosis. She had refused coronary bypass surgery. In concordance with patient preference and heart team consensus, she was referred for percutaneous revascularization to our hospital.

PAST MEDICAL HISTORY

The patient had well-controlled diabetes mellitus and hypertension. Although she had an angiographically

From the First Department of Cardiology, American Hellenic Educational and Progressive Association University Hospital, School of Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki, Greece.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

Manuscript received November 29, 2020; revised manuscript received January 26, 2021, accepted February 15, 2021.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2021.02.013

confirmed coronary artery disease 6 months before, she had no prior history of myocardial infarction.

DIFFERENTIAL DIAGNOSIS

Her typical of angina pectoris symptoms and known coronary anatomy narrowed down the differential diagnosis to cardiac ischemia alone.

INVESTIGATIONS

Vital signs and physical and electrocardiogram examinations were within normal limits. The echocardiogram showed a borderline normal left ventricular ejection fraction with no evidence of regional wall motion abnormalities. The high-sensitivity troponin T levels were normal. The rest of the blood tests were unremarkable.

MANAGEMENT

Revascularization of the RCA CTO via the antegrade approach was chosen as the first step of the procedure by the heart team consensus. Coronary angiography confirmed the known lesions: an RCA CTO with retrograde filling via septal collaterals from the LAD, along with a critical mid-LAD stenosis (**Figures 1A and 1B**, Videos 1 and 2). A 6-F Judkins right 4 guiding catheter was used via the right radial approach without a contralateral catheter in the left system. The anchoring balloon technique was used in a proximal side branch to stabilize the catheter. A Sion blue wire (Asahi Intecc, Seto-shi, Japan) was initially used to cross the occlusion unsuccessfully. Subsequently, a Fine-cross microcatheter (MC) (Terumo, Tokyo, Japan) was used to support the same guidewire, again without success. A Gaia Second wire (Asahi Intecc was then chosen and was quickly advanced. No resistance was felt in crossing and a repetitive course of the guidewire seemed to track the angiographic course of the RCA; true-to-true crossing success was assumed. The occlusion was then predilated with an Artimes 1.25 × 10 mm (BrosMed, Dongguan, China), followed by a 2.5 × 30 mm balloon (**Figure 1C**, Video 3). Both balloons crossed without any feeling of resistance. After the second balloon inflation, the patient was immediately hemodynamically destabilized. Contrast injection showed extravasation through the hole created by the balloon inflation into the pericardium,

ABBREVIATIONS AND ACRONYMS

CS = covered stent

CTO = chronic total occlusion

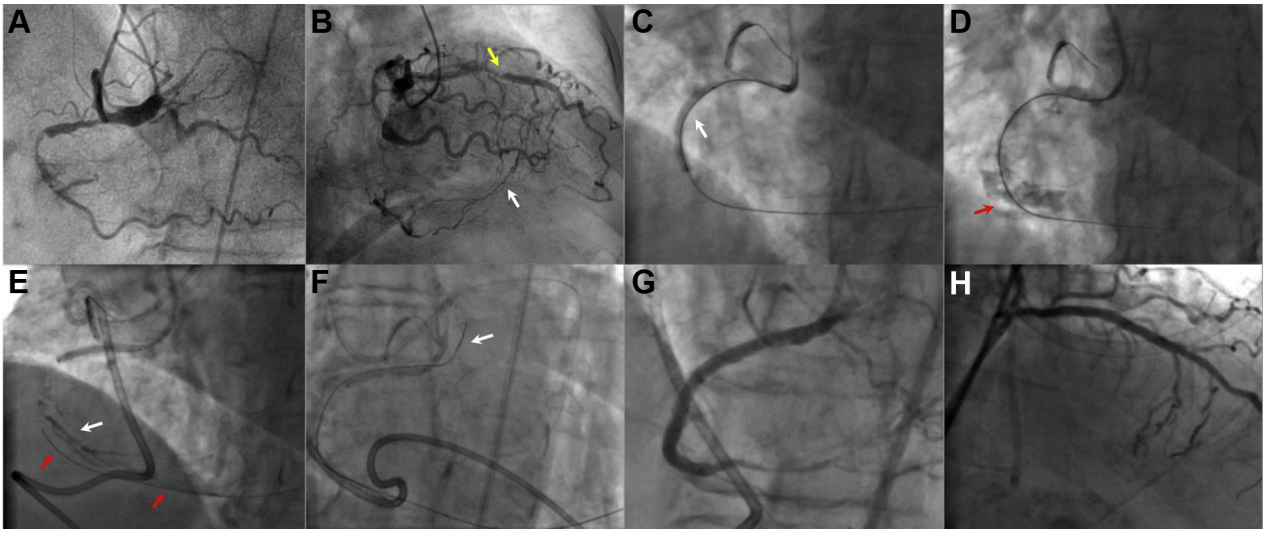
DES = drug-eluting stent

LAD = left anterior descending coronary artery

MC = microcatheter

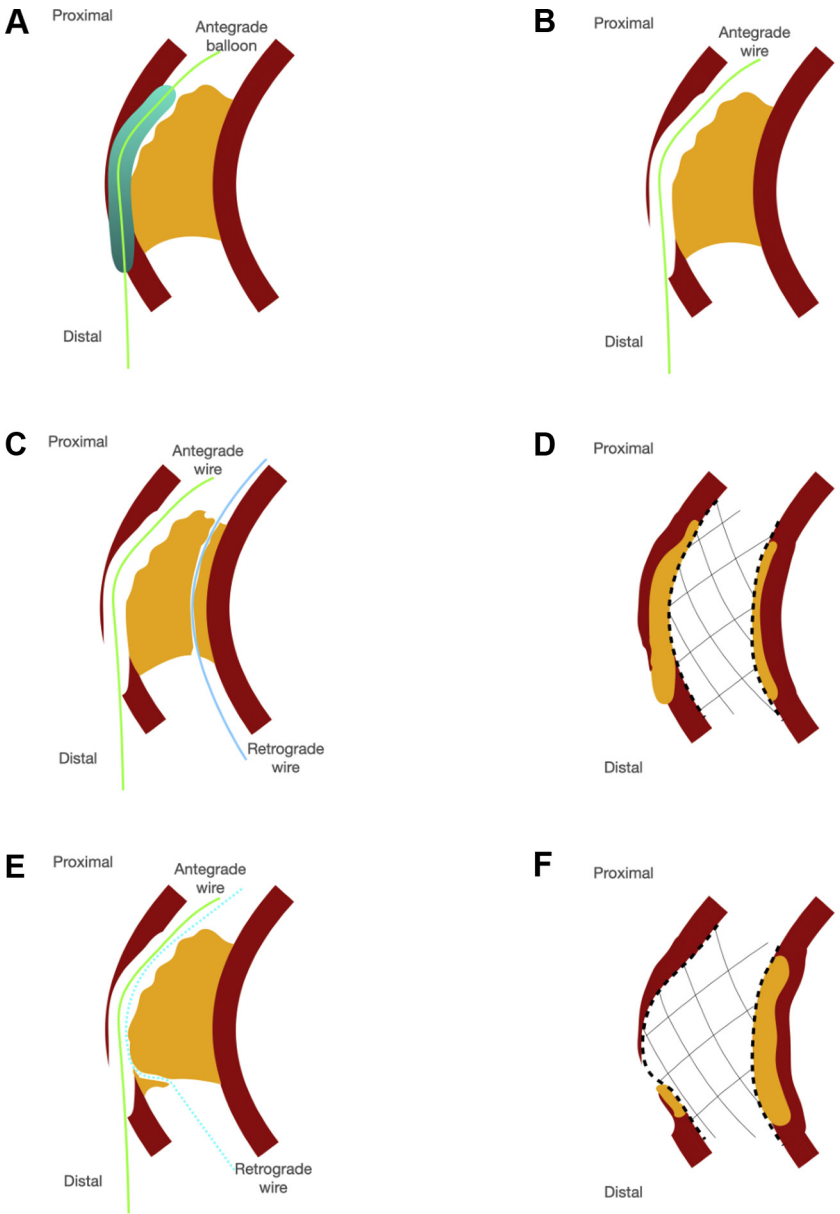
RCA = Right coronary artery

FIGURE 1 Angiographic Images of the Case



(A, B) The proximal right coronary artery (RCA) occlusion, visualized with separate antegrade and retrograde contrast injections. Side branch–like, tortuous, continuous transseptal collaterals from the left anterior descending coronary artery (LAD) supply the distal RCA **(white arrow).** Notice the mid-LAD severe focal stenosis **(yellow arrow). (C)** Lesion was assumingly crossed by antegrade wire escalation, facilitated by proximal anchor technique. Notice the guidewire course mimicking the imaginary contour of the native RCA artery. Crossing was not confirmed by contralateral injection, and 2 compliant balloons were inflated to dilate the lesion **(white arrow). (D)** Ellis type III coronary perforation into the pericardial space **(red arrow). (E)** Delivery of the microcatheter to the distal cap **(white arrow),** following proximal balloon inflation and placement of a pigtail pericardiocentesis catheter. Notice the ectopic guidewire into the pericardium **(red arrows). (F)** Wire system externalization through the crossed lesion and the transiently deflated proximal balloon **(white arrow). (G, H)** Final result. Sealing by deploying 2 drug-eluting stents, overlapping at the area of the perforation. The mid-LAD lesion was treated with a drug-eluting stent with a similarly excellent result.

FIGURE 2 Schematic of the Case



(A, B) Perforation caused by antegrade ballooning. **(C)** Retrograde crossing of the lesion with a guidewire away from the perforation site (true retrograde crossing). **(D)** Sealing the perforation by crushing the body of the lesion onto the vessel walls. **(E, F)** An alternative scenario, where the retrograde wire navigated the lesion through the connection created by antegrade ballooning (reverse controlled antegrade and retrograde subintimal tracking technique). In this unfavorable scenario, a covered stent would be necessary.

corresponding to an Ellis type III perforation (**Figure 1D**, Video 4) and tamponade with tachycardia and severe hypotension rapidly developed.

The 2.5 × 30mm balloon was immediately inflated in proximal RCA, far from the perforation site, to prevent further blood extravasation. Urgent pericardiocentesis was performed with placement of a pigtail catheter into the pericardium, and repeated autologous reinfusion of the drained pericardial blood (400 ml). Subsequently, the patient was hemodynamically stabilized. Retrograde access was urgently obtained through the right femoral artery with placement of a 7-F extra backup 4 guiding catheter at the left main. Contrast injection confirmed the presence of the

Gaia Second wire into the pericardium far from the true distal RCA (Video 5). A Sion black wire successfully crossed the septal collaterals, but the supporting Corsair MC (Asahi Intecc) failed. Therefore, it was replaced by a Finecross MC, which was successfully advanced to the distal cap (**Figure 1E**, Video 6). A Gaia Second wire successfully penetrated the distal cap, crossed the occlusion, and reached the proximally inflated balloon. The balloon was transiently deflated, and the wire was advanced to the ascending aorta (**Figure 1F**); meanwhile, more blood had to be drained and reinfused from the pericardium to the patient. The same maneuver had to be performed until the wire and the retrograde MC was advanced to the antegrade guiding catheter. Following that, an RG3 (Asahi Intecc) wire was externalized. The occlusion was predilated with a semi-compliant balloon, and a Resolute (Medtronic, Minneapolis, Minnesota) 3.0 × 38 mm drug-eluting stent (DES) was implanted over the balloon-induced hole, minimizing contrast extravasation (Video 7). A second Resolute 3.5 × 38 mm DES was implanted proximally to cover the entire lesion length. After dilation with 4.0 noncompliant balloons, complete sealing of the perforation was achieved without CS implantation (**Figure 1G**, Video 8). The LAD lesion was also treated with a DES (**Figure 1H**); the final angiographic result was optimal (Video 9). Total procedure time was 90 min. The patient was then transferred to the coronary care unit. Pericardial drainage was pulled the next day after echocardiography revealed no pericardial effusion. The patient was discharged 2 days later in stable condition.

DISCUSSION

This is the first case reporting a CTO percutaneous coronary intervention-related large-vessel perforation being sealed successfully by a DES, using retrograde techniques. It can be assumed that the perforation (**Figures 2A and 2B**) was covered due to true retrograde wire crossing away from the space created by the balloon inflation (**Figure 2C**) and crushing the body of the lesion into this space (**Figure 2D**); thus, CS implantation was avoided. Had the retrograde wire crossed into the proximal true lumen, as in the classic reverse controlled antegrade and retrograde subintimal tracking, there might not be enough tissue to seal the perforation (**Figures 2E and 2F**). In this case, a CS would have been mandatory. Of note, this was a bailout technique, and its success probably reflected the play of chance. Direct antegrade access to the true lumen through the CTO lesion was considered impossible after the perforation because of the severe hemodynamic compromise coupled with each proximal balloon deflation. Ultimately, the perforation could have been avoided had contralateral injection been employed (2). This would allow complete visualization of lesion anatomy and monitoring of guidewire position during crossing and before dilation attempts. A dual catheter setup would also allow for a seamless transition to a retrograde strategy after the initial antegrade strategy failed.

FOLLOW-UP

The patient underwent follow-up coronary angiography 6 months later with preserved result. She remained free of angina since the initial procedure.

CONCLUSIONS

We describe a novel adaptation of the reverse controlled antegrade and retrograde subintimal tracking technique, used to salvage a large-vessel perforation with a DES, without need for CS implantation. Expertise in retrograde techniques from the CTO field can prove advantageous when dealing with a complication that precludes antegrade management.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr. Georgios Sianos, Department of Cardiology, Aristotle University of Thessaloniki, AHEPA University Hospital, St. Kiriakidi 1, 54636 Thessaloniki, Greece. E-mail: gsianos@auth.gr.

REFERENCES

1. Azzalini L, Poletti E, Ayoub M, et al. Coronary artery perforation during chronic total occlusion percutaneous coronary intervention: epidemiology, mechanisms, management, and outcomes. EuroIntervention 2019;5:e804–11.

2. Brilakis ES, Mashayekhi K, Tsuchikane E, et al. Guiding principles for chronic total occlusion percutaneous coronary intervention: a global expert consensus document. Circulation 2019; 140:420–33.

KEY WORDS case report, chronic total occlusion, complication, drug-eluting stent, percutaneous coronary intervention, perforation, sealing

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