



Case Report

Retrograde balloon crossing to overcome antegrade delivery failure for a heavily calcified chronic total occlusion



Kenji Sadamatsu (MD, PhD)^{a,*}, Kensuke Oe (MD)^a, Toshiya Muramatsu (MD)^b,
Hideki Tashiro (MD, PhD)^a

^a Department of Cardiology, St. Mary's Hospital, Kurume, Japan

^b Division of Cardiology, Tokyo Hospital, Tokyo, Japan

ARTICLE INFO

Article history:

Received 29 June 2018

Received in revised form 26 November 2018

Accepted 12 December 2018

Keywords:

Coronary disease

Computed tomography

Intravascular ultrasound

Angioplasty

ABSTRACT

We herein report a case of percutaneous coronary intervention to a heavily calcified chronic total occlusion in the left anterior descending artery. Although we successfully performed retrograde wire crossing and wire externalization, we were unable to deliver small-sized balloon catheters in the lesion antegradely, even with strong back-up of wire externalization because of the heavy calcium mass. However, a balloon catheter was easily crossed retrogradely, and the lesion was successfully treated. Thus, retrograde balloon crossing might be a way to overcome device delivery failure in calcified lesions.

<Learning objective: Dense calcium often prevents devices from passing through a chronic coronary total occlusion. In the present case, retrograde delivery through an epicardial collateral channel succeeded in balloon crossing, because changing the direction reversed the distribution of calcium for the passage.>

© 2019 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved.

Introduction

The success rate of guide wire crossing in coronary intervention to chronic total occlusions has been increasing with the improvement in guide wire performance and the widespread use of retrograde techniques. However, device delivery failure remains a main reason for technical failure [1], and the presence of heavy calcium masses is one factor preventing devices from crossing through the occlusion.

We herein report a case of a heavily calcified coronary occlusion lesion in the left anterior descending artery that was successfully treated with the retrograde balloon crossing technique.

Case report

A 64-year-old man with intermittent claudication was admitted to our hospital. His risk factors were diabetes,

hypertension, hyperlipidemia, and a history of smoking. Angiograms showed severe stenosis in the right femoral artery and the left popliteal and anterior tibial arteries, as well as total occlusion of the proximal left anterior descending coronary artery with an epicardial collateral channel from the right coronary artery (Figs. 1 and 2A). After endarterectomy for the right femoral artery and balloon angioplasty for the left popliteal and anterior tibial arteries, we evaluated his myocardial ischemia via cardiac scintigraphy. Although the left ventricular systolic function was preserved and he had no complaints of chest pain, a large perfusion defect with redistribution in the anterior wall was demonstrated, so we tried to open the left anterior descending artery. However, severe coronary calcification that had been noted on coronary computed tomography angiography (Fig. 2G) prevented the guidewire from crossing through the occlusion antegradely. We therefore tried to treat the lesion via the retrograde approach in our second attempt at coronary intervention. Using an 8-Fr extra back-up-type guide catheter (Luncher EBU3.5 SH; Medtronic Vascular, Santa Rosa, CA, USA) via the left femoral artery, we started antegrade crossing with a gradual increase in the wire stiffness; however, we failed to cross the lesion even with a

* Corresponding author at: Department of Cardiology, St. Mary's Hospital, 422 Tsubukuhon-machi, Kurume, Fukuoka, 830-8543, Japan.
E-mail address: k-sadamatsu@umin.ac.jp (K. Sadamatsu).

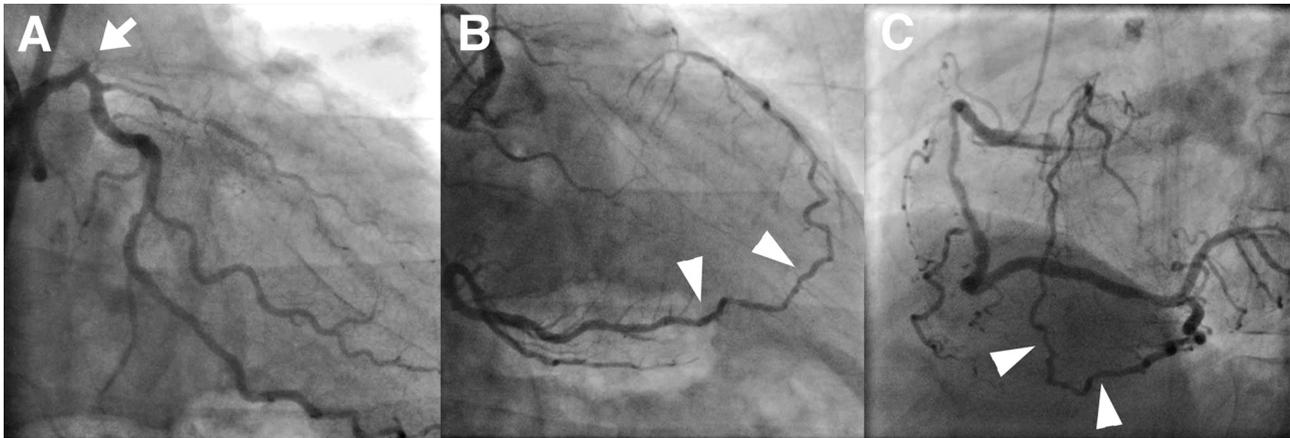


Fig. 1. Pre-procedural coronary angiography. Left coronary angiography at the right anterior oblique-caudal projection (A) showed a total occlusion in the ostium of the left anterior descending coronary artery (arrow). Right coronary angiography at the right anterior oblique-caudal (B) and the left anterior projections (C) demonstrated that the right coronary artery supplied a good collateral flow of an epicardial channel (arrow heads) to the left anterior descending artery.

tapered wire with a tip load of 12 g (Conquest Pro 12; Asahi Intecc, Nagoya, Japan) (Fig. 2B). We then engaged a 7-Fr Amplatz left-type guide catheter (Launcher AL1 SH; Medtronic Vascular) via the right brachial artery and advanced a floppy guide wire through the epicardial connection and successfully crossed the lesion with a contemporary wire with good torque control (Gaia second; Asahi Intecc). We delivered a microcatheter (Finecross GT, Terumo, Tokyo, Japan) to the guide catheter at the left coronary artery and changed the wire for externalization. However, we were unable to deliver any small-sized balloon catheters through the occluded lesion antegradely despite good back-up with externalization (Fig. 2C). Since we had crossed the microcatheter retrogradely, we attempted retrograde crossing with a 2.0-mm balloon catheter (Traveler; Abbott Vascular, Santa Clara, CA, USA) and fortunately succeeded in delivering and dilating the lesion (Fig. 2D; Video S1). We were then able to deliver a balloon catheter antegradely (Fig. 2E) and ablated the lesion with rotational atherectomy using a 1.25-mm burr (Rotablator; Boston Scientific, Boston, MA, USA). Intravascular ultrasound demonstrated that the lesion calcification was circumferential at the distal site (Fig. 2G3,4) and it was also distributed on the myocardial side at the proximal site of the mid segment of the left anterior descending artery (Fig. 2G1,2). The calcification in the proximal segment was located just eccentrically. We deployed three drug-eluting stents (Xience Alpine; Abbott Vascular) with a good result (Fig. 2F). The patient was discharged without any complications.

Discussion

Chronic total occlusion remains a challenge to treat with percutaneous coronary intervention, due in large part to the presence of dense calcium, which often prevents devices from passing through the lesion. Moderate or severe calcification is associated with a decreased likelihood of successful guide wire crossing in the first 30 min, and lesion calcification is an independent predictor for procedure failure even after successful retrograde channel crossing [2]. In the present case, we successfully placed a guide wire through the total occlusion at the second attempt; however, the dense calcium mass that had led to our failure on the first attempt remained an obstacle for balloon passage. Although we were not able to deliver

contemporary small-sized balloon catheters even when utilizing a strong back-up of wire externalization, retrograde balloon delivery easily overcame the issue in the present case. The findings of computed tomography and intravascular ultrasound suggest that the transition from an eccentric calcified lesion to a circumferential area of heavy calcification might prevent the tip of the balloon catheter from passing through the calcium mass and prevent antegrade balloon delivery (Fig. 2G). Changing the direction from antegrade to retrograde, which reversed the distribution of calcium for the balloon passage, helped the balloon tip slip through the calcium mass, thereby enabling the resolution of this issue. In addition, a long calcified lesion in the proximal left anterior descending artery might reduce the antegrade pushing force that allows balloon catheters to pass through the occlusion.

On occasion, chronic total occlusion lesions cannot be crossed or dilated with a balloon. Therefore, delivering a small balloon catheter or a microcatheter using a strong back-up with wire externalization will lead to successful passage in almost all such cases. Other options for negotiating a long and heavily calcified lesion are limited and complicated [3], making retrograde balloon crossing a simple method with a good indication for the present case, as the epicardial collateral channel was large enough to deliver a balloon catheter. Although retrograde balloon crossing is one step in the procedure of controlled antegrade and retrograde subintimal tracking [4] and a case of retrograde stent passage has been also reported [5], its use remains unfamiliar to most interventionists, except for experienced specialists. We should bear in mind this option in the treatment of chronic total occlusions. When performing this technique, we should pay attention to the potential complication of retrograde channel damage with balloon passage. Therefore, it is better to deliver a retrograde balloon catheter using an extension guide catheter in order to avoid injuring a donor artery with the exit port of the balloon catheter when the retrograde course is relatively long, although we did not need to use it in the present case.

In conclusion, heavy calcification may prevent device delivery and result in technical failure in the treatment of chronic total occlusions even after successful wire externalization. Retrograde delivery might enable successful balloon crossing through calcified lesions.

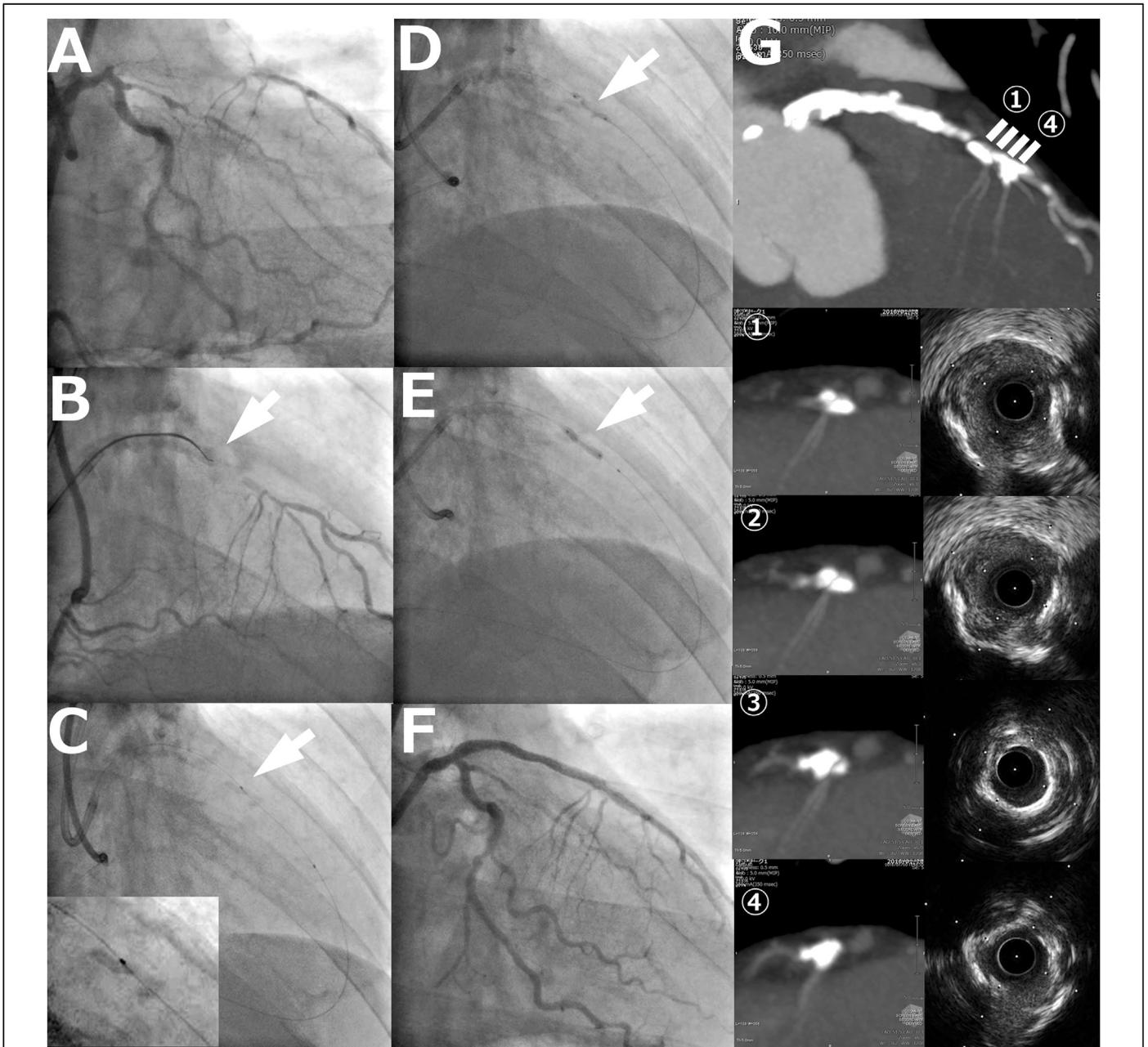


Fig. 2.

Images of coronary angiography, coronary computed tomography angiography, and intravascular ultrasound. (A) Bilateral left coronary angiography at the right anterior oblique-caudal projection demonstrated total occlusion in the proximal left anterior descending artery. (B) A right anterior oblique-cranial projection image showed that the antegrade wire could not proceed (arrow) to the bifurcation of the septal branches, which were enhanced with the collateral flow from the right coronary artery. (C) Although retrograde wire crossing and externalization were completed, a 1.0-mm balloon catheter (arrow) could not cross the calcified occlusion. The magnified image in panel C shows the center marker of the balloon catheter between two blocks of calcium mass. (D) Retrograde delivery of a balloon catheter resulted in easy crossing (arrow; Video S1), and (E) a balloon catheter was finally able to be delivered antegradely, although the calcified lesion was not dilated fully (arrow). (F) The final result after stent deployment was good. (G) Coronary computed tomography angiography revealed diffuse calcification in the left anterior descending artery and two blocks of calcium mass at the bifurcation of the septal branches. The bars indicate the position of the axial images and corresponding intravascular ultrasound images, and the numbers were assigned from the proximal site. Axial images of computed tomography showed that the proximal calcium (1,2) was distributed at the myocardial side (lower side), while the distal calcium (3,4) occupied almost the entire vessel area, with some overlapping. Intravascular ultrasound after rotational atherectomy showed that the calcium was located at the myocardial side (lower side) for the proximal mass (1,2) with severe circumferential calcification at the distal mass (3,4).

Acknowledgment

The authors acknowledge Prof. Satoru Sumitsuji (Osaka University) for his valuable suggestions on this technique.

Conflict of interest

The authors declare that there is no conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.jccase.2018.12.009>.

References

- [1] Suzuki Y, Tsuchikane E, Katoh O, Muramatsu T, Muto M, Kishi K, et al. Outcomes of percutaneous coronary interventions for chronic total occlusion performed

- by highly experienced Japanese specialists: the first report from the Japanese CTO-PCI Expert Registry. *JACC Cardiovasc Interv* 2017;10:2144–54.
- [2] Suzuki Y, Muto M, Yamane M, Muramatsu T, Okamura A, Igarashi Y, et al. Independent predictors of retrograde failure in CTO-PCI after successful collateral channel crossing. *Catheter Cardiovasc Interv* 2017;90:E11–8.
- [3] Karacsonyi J, Karpalotis D, Alaswad K, Jaffer FA, Yeh RW, Patel M, et al. Prevalence, indications and management of balloon uncrossable chronic total occlusions: insights from a contemporary multicenter US registry. *Catheter Cardiovasc Interv* 2017;90:12–20.
- [4] Surmely J, Katoh O. Bilateral approach. In: Waksman R, Saito S, editors. *Chronic total occlusions*. Chichester: Wiley-Blackwell; 2009. p. 107–12.
- [5] Bansal D, Uretsky BF. Treatment of chronic total occlusion by retrograde passage of stents through an epicardial collateral vessel. *Catheter Cardiovasc Interv* 2008;72:365–9.