Switching Rotablator Burr from 1.25 mm to 1.5 mm for an Uncrossable, Calcified and Angulated Left Anterior Descending Lesion

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Abstract

We describe a case of a hemodialysis patient who presented with acute coronary syndrome. The culprit lesion mainly involved the left anterior descending artery. Rotablation was imperative to debulk and crack the calcified plaque inside the vessel wall. However, the vessel was highly angulated, making the procedure quite difficult and risky. The operator adopted a counterintuitive strategy, to size up the burr from 1.25 mm to 1.5 mm and successfully crossed the angulated lesion without complications. We discuss possible mechanisms, based on the structural difference between the 1.25 mm and 1.5 mm burrs.

Keywords: rotational atherectomy, burr size

Introduction

Severely calcified lesions remain a formidable challenge in coronary intervention to this day. Rotational atherectomy (RA) is considered the last resort to conquer such calcified lesions. The objective of RA is plaque modification, i.e. to crack the continuity of the intravascular calcium rings and facilitate proper balloon dilatation and stent implantation.[1] In the drug-eluting stent era, a smaller burr size (1.25 mm or 1.5 mm) is generally recommended for the purpose of plaque modification.[2,3] When a burr cannot penetrate the lesion, general practice is to downsize the burr.[3] However, if the smallest burr (1.25 mm) still cannot penetrate the lesion, operators are faced with limited choices, one of the worst being forceful burr manipulation. Forceful burr manipulation can easily cause vessel perforation, burr entrapment or wire transection, especially in large, angulated vessels, and should be avoided.[2,4] We present a case of acute coronary syndrome with an uncrossable, calcified and highly angulated left anterior descending lesion. After failing to penetrate with the smallest burr, we upsized the burr and successfully treated the lesion without further complications.

Case Presentation

Our patient was a 76-year-old woman who complained of chest oppression, on and off, for

Received: Jul. 1, 2022; Accepted: Jul. 19, 2022
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days. She also suffered end-stage renal disease and had undergone regular hemodialysis for over 20 years. Mechanical circulatory support was not feasible because of severe peripheral artery disease. Coronary angiography showed calcified and tubular stenosis in the middle part of the right coronary artery (Figure 1A), with preserved blood flow. The left anterior descending artery was severely diseased (Figure 1B). In addition to heavy calcification and tight stenosis, two approx. 90-degree angulated lesions were noted in the middle left anterior descending artery. The distal left circumflex had a chronic total occlusion lesion (Figure 1C). After discussion with the patient and family, percutaneous coronary intervention was preferred, over coronary bypass surgery. Due to the patient's peripheral artery disease, only the right femoral artery was suitable for vascular access. We used a 7Fr EBU 4.5 as our guiding catheter. An intravascular ultrasound catheter could not cross the lesion due to the severe calcification. After exchanging the Sion Blue (Asahi Intecc Medical) wire for a RotaWire Floppy (Boston Scientific, Marlborough, MA, USA), we started rotablation with a 1.25 mm rotablator burr (Rotablator, Boston Scientific, Natick, MA, USA). The RA speed was set at 180K – 190K rpm. After 4 rounds of RA with a total duration of 65 seconds, the 1.25 mm burr still could not cross the second angulated lesion of the left anterior descending artery (Figure 2A). The RA speed dropped to less than 3000 rpm during the procedure. Suspecting that the diamond coating of the 1.25 mm burr was not making contact with the area of calcification, we took the

Figure 1A. Pre-treatment right coronary angiography. Severe stenosis and heavy calcification was noted in the middle right coronary artery.

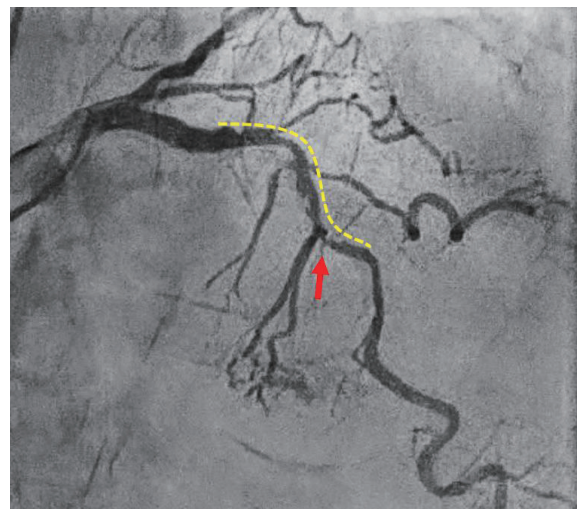

Figure 1B. Pre-treatment coronary angiography of the left coronary artery. The middle left anterior descending artery (yellow dashed line) contains two angulated lesions. The red arrow points to the tightest section in the second angulated lesion.

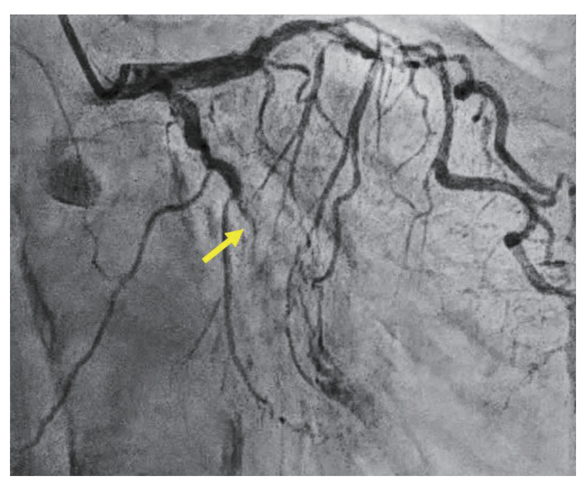

Figure 1C. Pre-treatment coronary angiography of the left coronary artery. The yellow arrow points to the total occlusion of the distal circumflex artery.

unusual step of switching from the 1.25 mm burr to a 1.5 mm burr. The 1.5 mm burr successfully crossed the lesion after 3 rounds, with a total duration of 45 seconds (Figure 2B). We used a 2.5 x 15 mm cutting balloon for angioplasty and deployed 2.5 x 30 mm and 3.0 x 30 mm drug eluting stents along the left anterior descending artery. After non-compliant balloon angioplasty (3.0 mm and 3.5 mm), the angiography showed optimal results (Figure 3). Staged percutaneous coronary intervention for the right coronary artery was performed 2 days later with good results (Figure 4). The patient recovered well after the procedure.

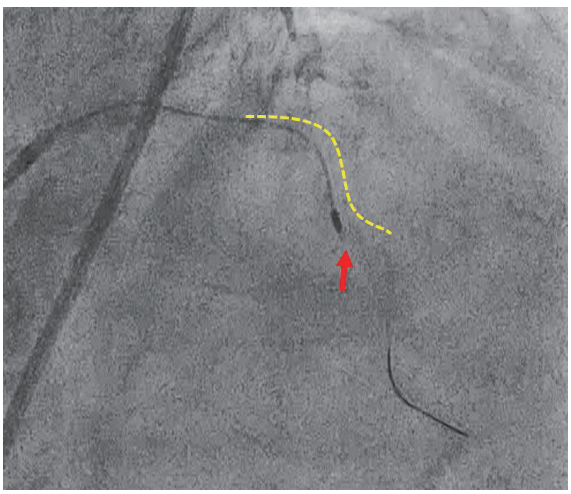

Figure 2A. A 1.25 mm burr could not cross the second angulated lesion (red arrow). The yellow dashed line shows the contour of the middle left anterior descending artery.

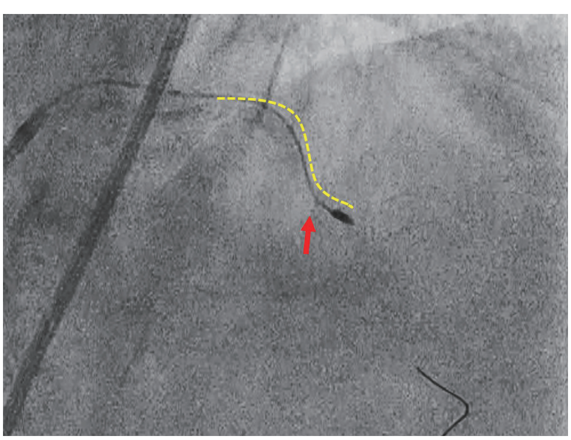

Figure 2B. A 1.5 mm burr crossed the second angulated lesion. The yellow dashed line shows the contour of the middle left anterior descending artery and the red arrow points to the second angulated lesion of the left anterior descending artery.

Discussion

To overcome uncrossable, calcified and angulated lesions, options for operators to try include increasing the RA speed, downsizing the burr, changing to extra-support wire, combining

Figure 3. Post-treatment coronary angiography of the left anterior descending artery.

Figure 4. Post-treatment coronary angiography of the right coronary artery.

with guide-extension catheter or doing halfway RA.[5-10] In our case, the RA speed was already close to the recommended maximum speed and the 1.25 mm burr was the smallest burr available.[5] Extra-support wire was a possible solution, but may have stretched the vessel and caused unfavorable wire bias.[2,6] The left anterior descending artery contained a 90-degree angle, and a RotaWire Floppy would have followed the vessel without distorting the vessel configuration, but the extra-support wire might have biased the wire toward the pericardium side, resulting in a risk of vessel perforation during RA.[2] Guide-extension catheter is useful for deploying devices in very tight lesions with tortuosity, and a few cases of RA via guide-extension have been reported.[7,8] A guide-extension can provide strong back-up support and possibly shift the wire bias to favorable sites.[7,8] One drawback of guide-extension would have been the significant friction or potential entrapment of the RA catheter at the entry port if we had chosen a 5.5 or 6 Fr guide extension. With a larger guide-extension size, the risk of coronary ischemia or coronary dissection would have been higher.[7,8] Halfway RA is another way to treat lesions with a large angle. Operators can perform RA up to, but not beyond the angle so as to avoid burr entrapment or vessel perforation, and leave the bent lesion for small balloon angioplasty.[9,10] Halfway RA might have been the safest way to treat this bent lesion, but it was to be expected that vessel preparation would be suboptimal.

Intentionally upsizing the burr is a counterintuitive management strategy for a calcified, angular lesion. One mechanism by which the larger, 1.5 mm burr may succeed is by increasing the effective contact with the calcium. When we performed RA with the 1.25 mm burr, we noted an absence of adequate speed deceleration. This phenomenon indicated insufficient contact with the calcium by the 1.25 mm burr.[2] Had the operator continued to push the burr strongly, vessel perforation or burr entrapment might easily have occurred. A second possible mechanism has to do with the structural difference between the 1.25 mm and the 1.5 mm burr. The length of each burr is about 5 mm, and the diamond crystal coating is only on the leading edge of the burr, followed by a non-coated trailing edge.[5] By comparison, the 1.25 mm burr has a longer non-coated part, but a shorter diamond crystal coated part than the 1.5 mm burr.[5] This longer, non-diamond crystal coated trailing edge might hinder the ability of the burr to cross the lesion. Moreover, based on RA models introduced by Sakakura et al., the required vessel diameter for oblique 1.25 mm and 1.5 mm burrs to cross is almost the same.[11] To sum up, the 1.5 mm burr was able to cross the angulated lesion more easily because of the larger calcium contact area, the shorter non-diamond crystal coated trailing edge and almost the same crossing profile as the 1.25 mm burr in the second angulated lesion (Figure 5).

Conclusions

Treating large, angulated lesions with RA is always difficult and risky. Understanding the pros and cons of various skills helps operators to treat patients successfully and safely in different cases. Sometimes, when a 1.25 mm burr cannot cross a calcified and angulated lesion, upsizing to a 1.5 mm burr could be a reasonable strategy.

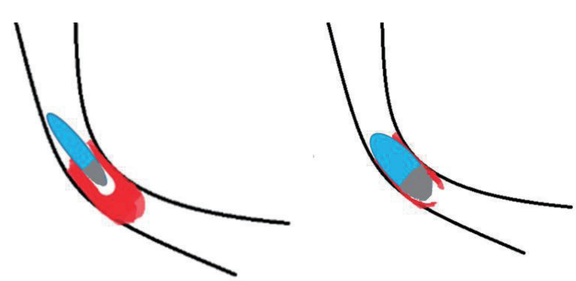

Figure 5. Illustrations to clarify how the 1.5 mm burr (right) instead of the 1.25 mm burr (left) crossed the angulated lesion. The 1.5 mm burr was able to cross the lesion because of larger calcium contact area, shorter non-diamond crystal coated trailing edge and almost the same crossing profile in the angulated part.

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