Case Report: Successful Retrieval of Stuck Burr in an Angulated Coronary Lesion

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Abstract

A stuck Rota burr is always the last situation that the interventional cardiologist wants to encounter. Past case reports have introduced the application of a guide extension catheter (such as 5 Fr. catheter or the GuideLiner® catheter) to deal with this tricky complication. In our presented case, a rapid-exchange extension catheter showed its advantage (smaller profile and softer) in more complex lesions in which traditional extension catheter failed.

Keywords: rotablation, stuck burr retrieval

Introduction

As the aged population increases and new techniques (such as transcatheter aortic valve implantation) are developed, the need for dealing with calcified lesions when performing percutaneous coronary intervention (PCI) is burgeoning. Ample evidence from imaging studies has emphasized the importance of proper advance preparation of lesions in order to prevent stenting failure, especially stent under-expansion during PCI. Therefore, the 2021 ACC/AHA/SCAI guideline for coronary artery revascularization[4] highlights the role of devices such as the Rotablator (Boston scientific), Diamondback (Cardiovascular System Inc.), and Shockwave IVL system (Shockwave Medical) in treating calcified lesions. For purposes of procedural success, rotablation was classified as Class IIa, however in the past three decades, the major concern around rotablation has been the potential for lethal complications. According to a registry from Japan,[5] the procedural complication rate of rotablation is around 1.3%, and the incidence of stuck burr is 0.4-0.8%. A case report from Sakakura et al. demonstrates that a 6 Fr. GuideLiner® catheter (Vascular Solutions Inc., Minneapolis, Minnesota, United States) could be useful to retrieve a stuck burr in the LAD.[2] In our case report, the situation was similar but the vessel where the burr was stuck was more tortuous and the lesion was more complicated.

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Case report

An 87 year old male with a history of hypertension, chronic kidney disease, and hyperlipidemia was admitted to the emergency department (ED) because of progressive symptoms including dyspnea on exertion, orthopnea, and exertional chest tightness noted for one week. At the ED, lab data showed elevated plasma NT-pro BNP level, and the chest X-ray showed cardiomegaly with bilateral pleural effusion. Hypoxia with SpO_2 down to 72% was also noted. Under the impression of decompensated heart failure with pulmonary edema, he was admitted to the intensive care unit for further management.

After admission, scintigraphy showed significant myocardial ischemia with total perfusion defect up to 10%. Hence, we arranged coronary angiography, which showed two-vessel coronary artery disease (CAD) with tortuous vessels and scattered, eccentric, calcified lesions (Figure 1a). Initially, we tried to dilate the calcified lesion in the proximal left circumflex coronary artery (LCX), but it was in vain, and intravascular ultrasound (IVUS) was also unable to pass the extremely tight lesion. Therefore, we decided to rotablate the eccentric plaque. We started rotational atherectomy (RA) to treat the proximal LCX lesion with a 1.25 mm and then 1.5 mm burr. After that, we attempted to treat the distal LCX critical stenosis by RA as well. We deployed the rotablator at m-LCX by Dynaglide mode and started RA again. After finishing RA, we tried to retract the advanced burr but found that it was stuck in the mid-LCX (Figures 1b, 1c).

When the burr became stuck at m-LCX, we cut the driver shaft and removed the outer sheath quickly. Initially, we tried to deliver a 5 Fr. straight catheter (Heartrail ST01, Terumo, Japan) to the lesion site to retract the stuck burr, but the angulated vessel as well as the proximal lesion interfered with the advance of the catheter. After several attempts, we switched to a 5.5 Fr. GuideLiner® V3 catheter (Vascular Solutions Inc., Minnesota, USA). Although it could reach the stuck burr, the whole system could still not be retracted. Then we tried the balloon replacement technique with balloon dilatation to the upstream stenotic lesions, but the ST01 catheter failed to reach the site where the burr was stuck. Subsequently, we tried a 6 Fr. GuideLiner® V3 catheter (Vascular Solutions, Inc.), but it too couldn't overcome the proximal obstacle, just as the ST01. Finally, we re-tried the 5.5 Fr. Guideliner and fixed the whole system by needle holder, whereupon the burr could be retrieved successfully (Figures 1d, 2a). Luckily the flow was good without vessel damage (Figure 2b).

Three days later, we repeated the angiography which showed TIMI 3 flow in the LCX (Figure 2c). Hence, we finished rotablation of the left anterior descending coronary artery (LAD) and completed the LAD-LCX bifurcation intervention by culotte stenting (Figure 2d).

Discussion

A stuck burr is the nightmare of any interventional cardiologist. An entrapped burr can not only obstruct coronary blood flow and cause myocardial ischemia, but also increases the risk of perforation or dissection during removal. Although it is always best to anticipate a problem before it arises, it can still happen accidentally. One of the potential mechanisms responsible for burr entrapment is known as the "Kokeshi phenomenon". As frictional heat from the ablation process expands the orifice of the calcified plaque, the burr may cross the lesion without significant ablation, and become entrapped on the other side as the plaque cools and contracts. This is furthered by the fact that the coefficient of friction is smaller in motion than at rest, making it easier for the moving burr to advance without performing significant ablation. This type of entrapment is usually noted when manipulating small burrs forcefully.[6] Another potential mechanism of entrapment involves the lesion morphology, such as eccentric plaque or angulated vessel. If the burr cannot ablate the lesion well because of improper

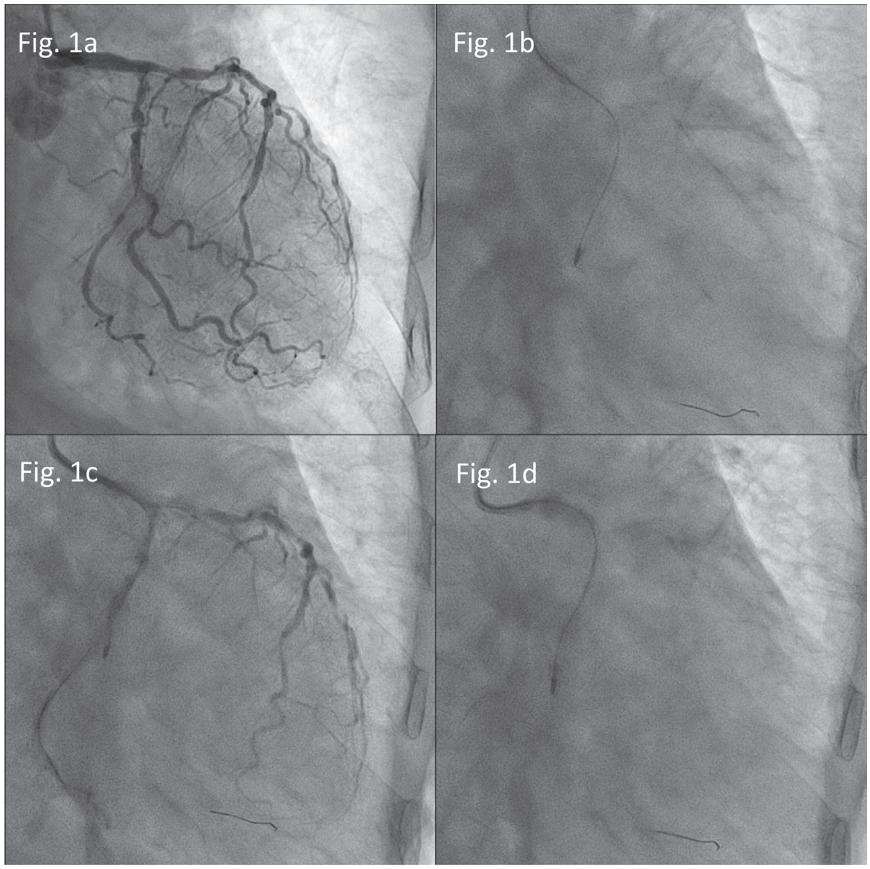

Figure 1. 1a. Angiography shows tandem lesion at proximal LCX. 1b. Ablation of m-LCX. 1c. The burr was stuck at the middle LCX. 1d. Delivery of a 5.5 Fr. Guideliner V3 catheter (Teleflex).

size or orientation, the burr tends to move towards the lesion's opposite side with less resistance. Therefore the burr might become entrapped at the proximal lesion.

In our case, we had ablated proximal to the middle lesion (Figure 1b), advanced the platform to the middle segment by Dynaglide mode, and then restarted RA. However, the timing of the entrapment of the burr was during retrieval of the whole system, not during forward ablation. This scenario is quite rare because, unlike the Kokeshi phenomenon, the burr was trapped when moving forward at high speed (> 180 k RPM). We did not feel any resistance during delivery or ablation, so the stuck burr was totally unexpected.

Aside from the two mechanisms we already know,[6] a further two possibilities might explain how the burr became entrapped in this case. First, the lesion was partially ablated so the burr could have passed through in Dynaglide mode. Given specific lesion morphology, such as eccentric plaque or tortuosity, it might have been easy to pass through but the lesion might have interfered with the burr withdrawal. This mechanism is similar to a plastic tie which allows only one-way passing. Furthermore, other mechanisms such as vasospasm might have exacerbated the difficulty in system withdrawal. While reviewing our procedure, we noticed that the site where the burr was stuck was one that we had ablated initially (Figures 1b, 1c). If the lesion had been ablated well, the burr might not have become stuck, however, we could not be sure if the lesion was ablated well or not because the intravascular image had not been checked at that moment. In summary, the possible causes of the stuck burr

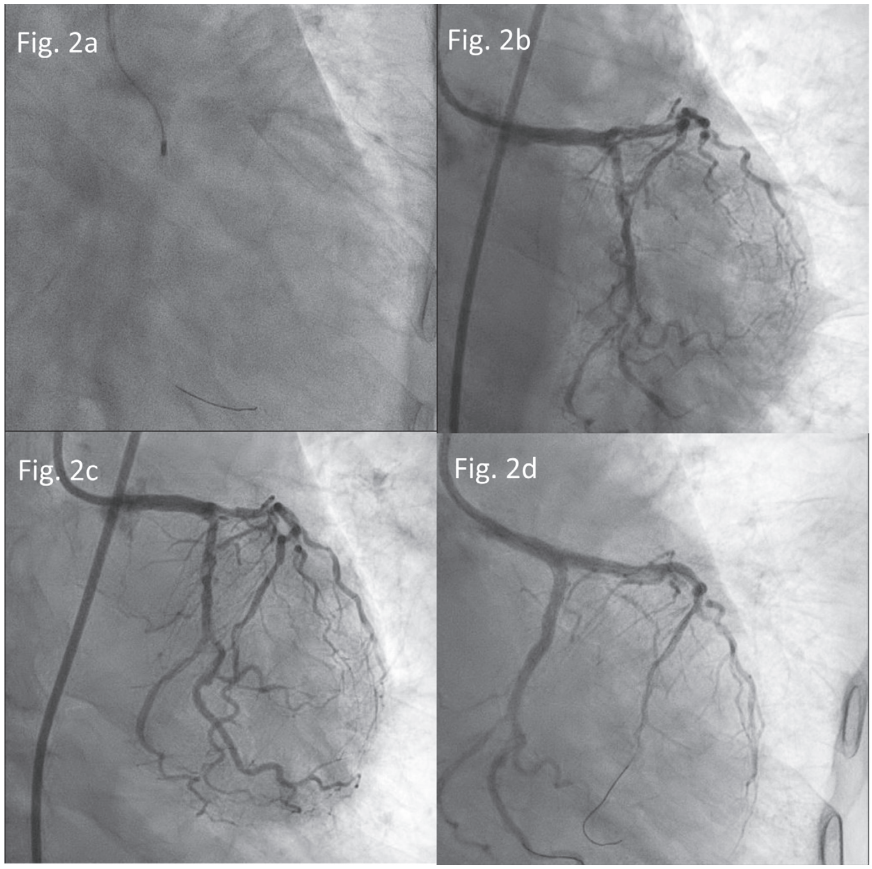

Figure 2. 2a. Successful retrieval of the 1.25 mm burr. 2b. Angiography after retrieval. 2c. Angiography follow-up on day 4. 2d. Final angiography after culotte stenting.

in this case might have been the under-treatment of the proximal LCX eccentric lesion, vessel angulation, or severe vascular spasm. This means we should be more careful about lesion ablation because the burr might become entrapped at a long, diffuse lesion even under Dynaglide mode.

The second, latent mechanism for the entrapment was that the final burr position might have been too close to the borderline lesion at the mid-LCX; once the burr was activated, friction as well as resistance decreased so that the burr passed through the mid-LCX borderline lesion easily. This means we should be more cautious when passing the burr through the proximal lesion, check the platform position and pause at a healthy site before RA activation.

According to Japanese consensus,[7] lots of methods could be applied to rescue an entrapped burr, one of them being the child-in-mother method using an extension catheter. Traditionally, a ST01 catheter has been the preferred choice, due to its good support. One case report describes retrieving the rotablator burr by soft extension catheter (e.g The GuideLiner® catheter)[2] which was used when the burr was stuck at a relatively proximal part of a straight vessel. In this case, the Guideliner was adopted when the traditional way failed; it was able to overcome the acute angle and the proximal tight lesion of the LCX, reach the stuck burr and facilitate system retrieval. However, this method might not work if a bigger burr is entrapped.

Table 1 and Table 2 compare different extension catheters used in daily practice. The Heartrail ST01 catheter has a larger inner diameter, better support, but higher friction. By

Table 1. Comparisons between the two types of extension catheter

	Characteristic
Heartrail ST01 catheter	120 cm long [20 cm longer than a standard guide catheter]; requires removal of the haemostatic valve, followed by advancement over the guide wire
Guideliner catheter	150 cm, rapid exchange, flexible 25 cm end

Table 2. Specifications of extension catheters and guide catheter

	Size	I.D.	O.D.
ST 01	5 Fr	1.5 mm	1.73 mm
	6 Fr	1.8 mm	
Guideliner V3	5.5 Fr	1.3 mm	1.6 mm
	6 Fr	1.42 mm	1.7 mm
	7 Fr	1.57 mm	1.9 mm
Guide catheter	6 Fr	1.78 mm (0.07”)	

I.D.: inner diameter; O.D.: outer diameter.

contrast, the rapid-exchange system has a smaller outer diameter, less friction, but longer working length. It is worth noting the shortcoming of the rapid-exchange extension catheter lies in the smaller inner diameter. The 5.5 Fr. Guideliner can accommodate a 1.25 mm burr, but if the stuck burr is 1.5 mm, only a ST01 catheter can fully accommodate it. *[The premise here is that the drive shaft sheath (1.42 mm/4.3 Fr) has been removed.] Nevertheless, even if the catheter isn’t able to completely contain the burr, we can potentially still retrieve it by the wedge effect. The advantage of the Guideliner is its flexibility for tortuous vessels. The ST01 catheter is too stiff to follow the angulated vessel curve, which could be navigated by the Guideliner catheter. Both extension catheters are available for operators to try to solve the burr entrapment complication.

To summarize, the rapid-exchange extension catheter could be a solution for burr entrapment because of thinner structure and better flexibility.

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