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INTERVENTIONS

CASE REPORT: CLINICAL CASE: TECHNICAL CORNER

Bailout Strategy for Paclitaxel-Coated Nitinol Self-Expanding Stent Deployment Failure

The Cut and Peel Technique

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ABSTRACT

The patient received endovascular therapy for a superficial femoral artery occlusion. Placement of a SMART stent distal to the lesion was successful, but deployment issues occurred with the Innova stent, requiring forceful retraction and causing elongation. The "cut and peel technique" was developed as a bailout strategy for such cases. (J Am Coll Cardiol Case Rep 2024;29:102177) © 2024 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/).

HISTORY OF PRESENTATION

An 89-year-old man presented at our medical facility with a primary report of dyspnea. The underlying etiology of his dyspnea was determined to be a combination of chronic obstructive pulmonary disease and pneumonia that warranted administration of antibiotic therapy. The patient exhibited cyanosis in the left toe and plantar region of the feet, along with a reduced ankle-brachial index (0.70 on the right and 0.73 on the left).

LEARNING OBJECTIVES

- To highlight that there may be instances during the procedure when the deployment of a paclitaxel-coated nitinol self-expanding stent becomes unfeasible.
- To address such cases, the cut and peel technique can be a viable bailout option.

PAST MEDICAL HISTORY

The patient had angina pectoris that developed after percutaneous coronary intervention, aortic valve stenosis that developed after aortic valve replacement, and dyslipidemia.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included peripheral arterial disease, chronic subclinical limb ischemia (CSLI), or chronic limb-threatening ischemia.

INVESTIGATIONS

Consequently, the patient underwent lower extremity arteriography, which revealed occlusion of the superficial femoral artery (**Figure 1A**). The presence of

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ABBREVIATIONS AND ACRONYMS

CSLI = chronic subclinical limb ischemia

IVUS = intravascular ultrasound

SFA = superficial femoral artery

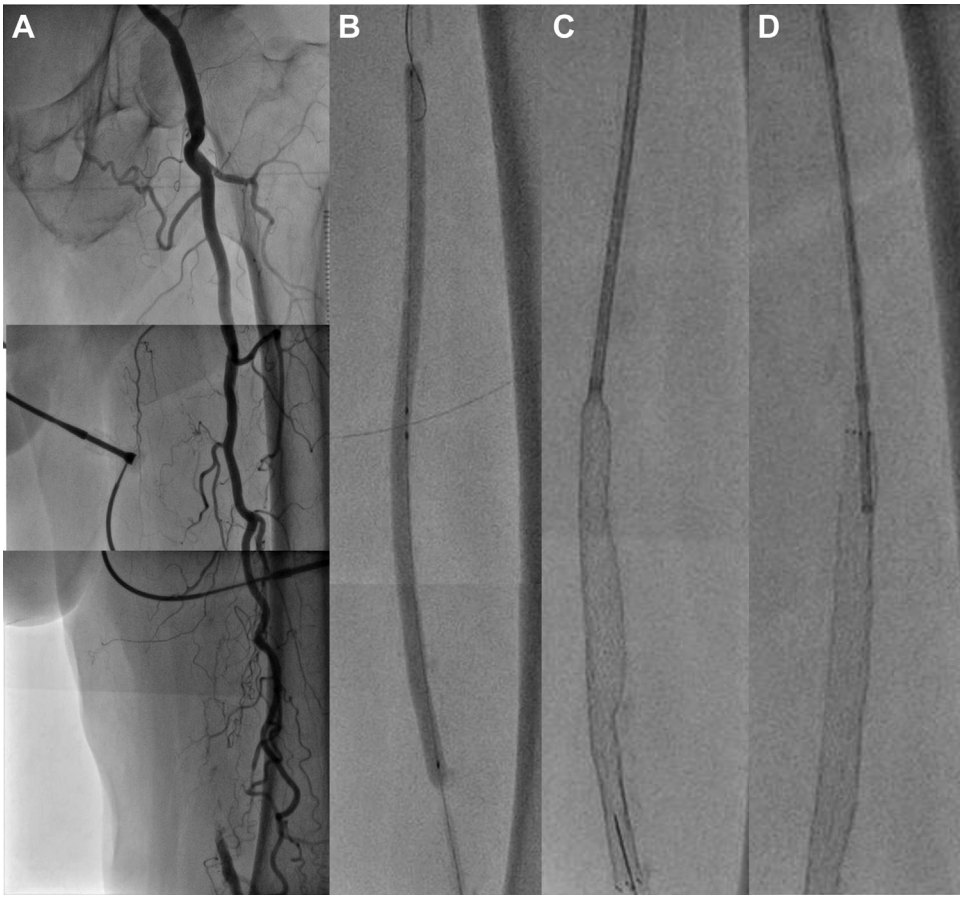
cold sensations and cyanosis, along with an absence of rest pain or ulceration, suggested that a diagnosis of CSLI was more suitable than that of chronic limb-threatening ischemia.[1] Moreover, CSLI associated with a low amputation-free survival rate prompted consideration of appropriate treatment options.[2]

MANAGEMENT

Endovascular intervention was performed to address the CSLI caused by occlusion of the left superficial femoral artery (SFA). The left popliteal artery was punctured under ultrasound guidance, and a 4-F sheath was inserted. When faced with a lengthy occlusion distance, our institution initiates the procedure by introducing the sheath into the popliteal artery under ultrasound guidance. Subsequently, the right femoral artery was punctured, and a 6-F Guiding Sheath Destination (Terumo) was introduced into the left femoral artery. The occlusion was observed at the origin of the left SFA. Initially, an antegrade wiring technique failed to traverse the lesion; subsequently, a retrograde wiring approach was successfully used.

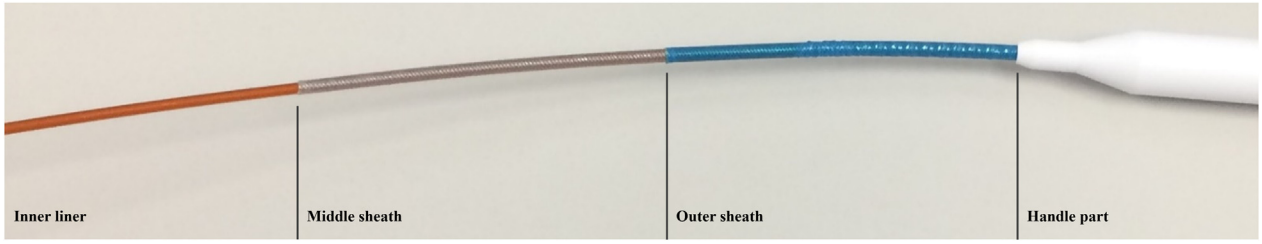
Following balloon dilation of the occlusion (Figure 1B), the intravascular ultrasound was examined. Although some dissection was induced by the balloon angioplasty, the guidewire traversed the intraplaque, with no calcification observed within the lesion. Adopting an antegrade approach, a SMART stent (bare nitinol self-expanding stent, 6 × 150 mm; Cordis) was implanted distally to the lesion

FIGURE 1 Occluded Left Superficial Femoral Artery



(A) Left superficial femoral artery is occluded from the ostium. Occlusion length is approximately 30 cm. (B) The occluded lesion is dilated with a 4 × 150 mm balloon. (C) Bare nitinol self-expanding stent deployment is initiated. (D) Completed bare nitinol self-expanding stent deployment.

FIGURE 2 **Balloon Dilation**



The paclitaxel-coated nitinol self-expanding stent delivery shaft comprises a 3-layered structure that includes an inner liner, a middle sheath, and an outer sheath.

(**Figures 1C and 1D**), and an Innova stent (paclitaxel-coated nitinol self-expanding stent, 7 × 150 mm; Boston Scientific) was positioned proximally to the lesion. At the outset, the stent deployment proceeded uneventfully. The thumbwheel exhibited a smooth rotation, allowing for the insertion of approximately 6 cm of the stent into the SFA. However, abruptly, the thumbwheel turned with an audible cracking sound, leading to the cessation of stent expansion. Because the thumbwheel was spinning freely, the stent could not be deployed. After consultation with the distributor, we were informed that stent placement is not possible if the thumbwheel is spinning freely. Hence, we had to pull the stent (Video 1). However, the stent had elongated and extended to the ostium of the left common iliac artery (Video 2). The intravascular ultrasound showed the stretched and broken stent metal (Video 3). Blood flow within the iliac artery remained unimpeded; consequently, new stent placement was deemed unnecessary.

DISCUSSION

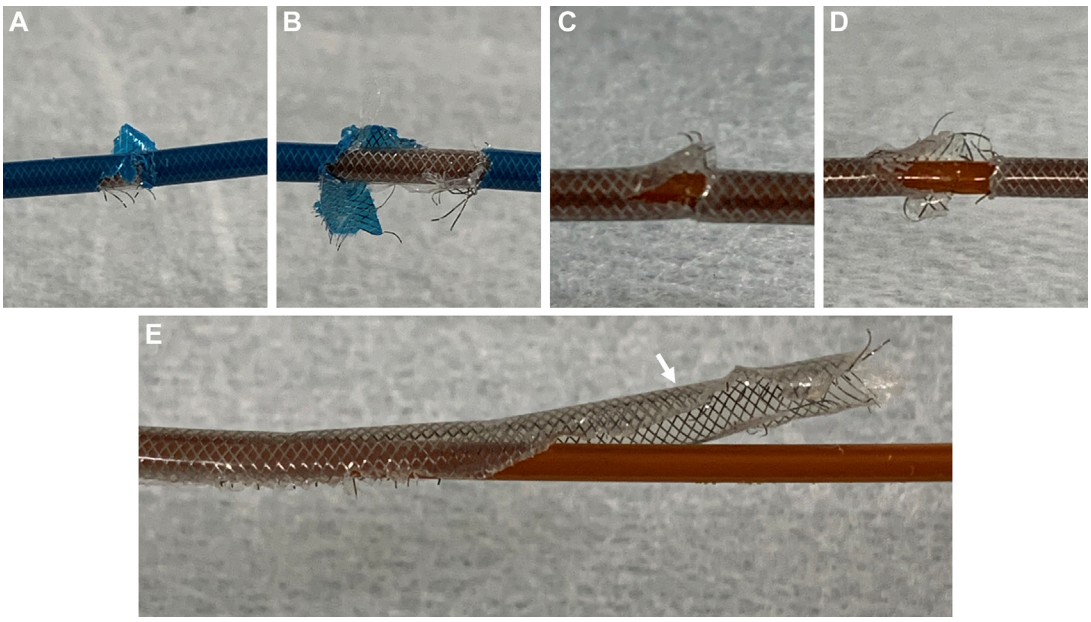
We encountered a case in which deployment of the paclitaxel-coated nitinol self-expanding stent was unsuccessful during the procedure. Although no scholarly articles specifically investigate the determinants impeding stent deployment, insufficiency in lesion dilatation, substantial lesion calcification, and pronounced aortic bifurcation into bilateral common iliac arteries are believed to be linked to the unsuccessful deployment of stents.

In the case of the paclitaxel-coated nitinol self-expanding stent, it is encased between the inner liner and the middle sheath, and the movement of the middle sheath is facilitated by turning the thumbwheel to deploy the stent. If the lesion is not adequately dilated or exhibits substantial calcification, the movement of the middle sheath may be impeded by the turning of the thumbwheel, resulting in unsuccessful stent deployment. However, in this case, appropriate pre-dilation was performed, no calcification was found, and the bare nitinol self-expanding stent was successfully implanted. When the bilateral common iliac arteries possess steep angles at the bifurcation, the delivery shaft of the stent may become kinked, hindering stent deployment. Nevertheless, in the present case, insertion of the guiding sheath from the right femoral artery to the left femoral artery was unproblematic, and the angle was not considered steep enough to cause kinking of the stent delivery shaft.

To our knowledge, no previous report has described a bailout method for a paclitaxel-coated nitinol self-expanding stent in which deployment failed during the procedure. Here, we introduce a stent deployment method without using a thumbwheel, which we termed “the cut and peel technique.” The paclitaxel-coated nitinol self-expanding stent delivery shaft comprises a 3-layered structure that includes an inner liner, a middle sheath, and an outer sheath (**Figure 2**). The stent is situated between the inner liner and the middle sheath, and the inner liner moves when the thumbwheel is rotated to deploy the stent. The cut and peel technique was performed as follows. First, a hole was created in the outer sheath using an 18-gauge needle. Only the outer sheath was peeled off to expose the middle sheath. Second, similarly, the middle sheath was peeled off using an 18-gauge needle to expose the inner liner. Finally, the stent was then deployed by grasping the inner liner and pulling the middle sheath (**Figure 3**).

Although Innova is no longer available in the market, Eluvia (Boston Scientific) has the same

FIGURE 3 Initiation of Stent Deployment: Completed Stent Deployment



Steps in the cut and peel technique: cut the outer sheath (A), peel off the outer sheath and expose the middle sheath (B), cut the middle sheath (C), peel off the middle sheath (D), and deploy the stent by grasping the inner liner and pulling the middle sheath (E). When pulling the middle sheath, holding the peeled portion (arrow) is more accessible.

delivery shaft structure as Innova. Therefore, the cut and peel technique can be used as a bailout technique for Eluvia in cases in which stent deployment fails.

FOLLOW-UP

One year passed without the patient exhibiting any evidence of worsening cyanosis or ulcer formation.

CONCLUSIONS

We encountered a case in which the deployment of the paclitaxel-coated nitinol self-expanding stent was unsuccessful during the procedure. However, we were able to use the cut and peel technique as a bailout method.

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KEY WORDS aged, angiography, bailout, peripheral artery disease, stents

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