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CASE REPORT

ADVANCED

CLINICAL CASE

# Antegrade Dissection Re-Entry After Subintimal Wiring of an Occluded Vessel From Spontaneous Coronary Artery Dissection

David V. Daniels, MD,[a] Vedant S. Pargaonkar, MD,[b] Takeshi Nishi, MD,[b] Jennifer A. Tremmel, MD, MS[b]

## ABSTRACT

Percutaneous management of spontaneous coronary artery dissection (SCAD) is challenging, with high procedural failure rates. We present a case of successful revascularization using antegrade dissection re-entry after failing to wire the true lumen in occlusive SCAD. Utilizing such alternative strategies may improve procedural success in this poorly understood patient subset. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2020;2:72–6)


## PRESENTATION

A 62-year-old postmenopausal woman with no significant cardiac risk factors presented to the emergency department with severe chest tightness radiating to her left arm and jaw, along with progressive shortness of breath. Her symptoms began the night prior but resolved until the next morning when they recurred. Her electrocardiogram showed anterior Q waves with marked ST-segment elevation (**Figure 1**). Her initial troponin I concentration was 13.6 ng/ml, and she was taken emergently to the cardiac catheterization laboratory.

### LEARNING OBJECTIVES

- To raise awareness of SCAD as a unique presentation of acute coronary syndrome.
- To demonstrate the challenges of percutaneous coronary intervention in this patient subset.
- To highlight the use of antegrade dissection re-entry as a bailout strategy in patients with SCAD.

## MEDICAL HISTORY

Her medical history included osteoporosis and breast cancer in situ with a complete mastectomy.

## DIFFERENTIAL DIAGNOSIS

Upon presenting with an ST-segment elevation myocardial infarction, her differential diagnosis included plaque rupture versus spasm versus spontaneous coronary artery dissection (SCAD).

## INVESTIGATIONS

Right and left coronary angiography revealed no significant obstructive disease in the dominant right coronary or left circumflex artery, whereas the left

From the [a]Cardiology Department, Sutter Health Palo Alto Medical Foundation, Burlingame, California; and the [b]Division of Cardiovascular Medicine, Stanford School of Medicine, Stanford California. Dr. Pargaonkar has received fellowship support from Gilead Sciences. Dr. Tremmel has received honoraria from Boston Scientific, Philips, and Terumo. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Informed consent was obtained for this case.

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anterior descending (LAD) artery tapered to a 100% mid occlusion without distal antegrade flow, consistent with SCAD (**Figure 2**, Video 1). Because of ongoing symptoms and ST segment elevation, as well as the complete absence of distal flow, it was decided to pursue percutaneous revascularization.

## MANAGEMENT

Through a 6-F extra back-up guide, a Runthrough wire (Terumo, Somerset, New Jersey), was advanced into the mid vessel, it quickly became apparent that the wire had gone into the subintimal space. This was confirmed by using intravascular ultrasonography (IVUS), which showed a compressed true lumen due to intramural hematoma (**Figure 3**). Given the high unlikelihood of being able to enter the true lumen, it was decided to attempt re-entry with a mini subintimal tracking and re-entry (mini-STAR) technique using a Fielder XT guide wire (Asahi Intecc, Aichi, Japan) through a Corsair microcatheter (Asahi Intecc). It was believed that the knuckle had re-entered (Video 2), but based on IVUS and angiography, the knuckle actually continued in the subintimal space without re-entry (**Figure 4**).

Next, in a final attempt to achieve re-entry, the StingRay re-entry system (Boston Scientific, Natick, Massachusetts) was used. The StingRay balloon was advanced to the distal vessel, and prior to the re-entry attempt, the hematoma from the subintimal space was withdrawn through the balloon catheter (using the subintimal transcatheter withdrawal [STRAW] technique). Approximately 3 ml of blood was aspirated, and the appearance of the lumen improved. Re-entry was then performed using a Confianza Pro 12 wire (Intecc, Aichi) and was confirmed by injection (**Figure 5**, Video 3). The workhorse wire was replaced, and the vessel was dilated with a 2.5-mm balloon followed by placement of a 2.75- × 38-mm drug-eluting stent. According to IVUS, the stent was well expanded without any evidence of residual dissection. Final angiography revealed a widely patent vessel with no residual stenosis, multiple intact distal side branches, and restoration of Thrombolysis in Myocardial Infarction flow grade 2 to 3 (Video 4).

The patient's troponin I concentration peaked at 21.5 ng/ml. A post-catheterization echocardiogram showed apical akinesis and some spontaneous echo contrast in the left ventricular (LV) apex without visualization of a thrombus. The overall LV ejection fraction (LVEF) was 40%. The patient remained asymptomatic and was discharged with a regimen of metoprolol, losartan, apixaban, and prasugrel.

## DISCUSSION

SCAD is a unique type of myocardial infarction that is not due to atherosclerosis but rather a separation of the arterial wall resulting in limited flow of the coronary artery. By definition, it is spontaneous rather

### ABBREVIATIONS AND ACRONYMS

**ADR** = antegrade dissection re-entry

**CABG** = coronary artery bypass grafting

**ED** = emergency department

**IVUS** = intravascular ultrasonography

**LAD** = left anterior descending artery

**LVEF** = left ventricular ejection fraction

**Mini-STAR** = mini subintimal tracking and re-entry

**PCI** = percutaneous coronary intervention

**SCAD** = spontaneous coronary artery dissection

**FIGURE 1 Electrocardiogram at Presentation in the Emergency Department**

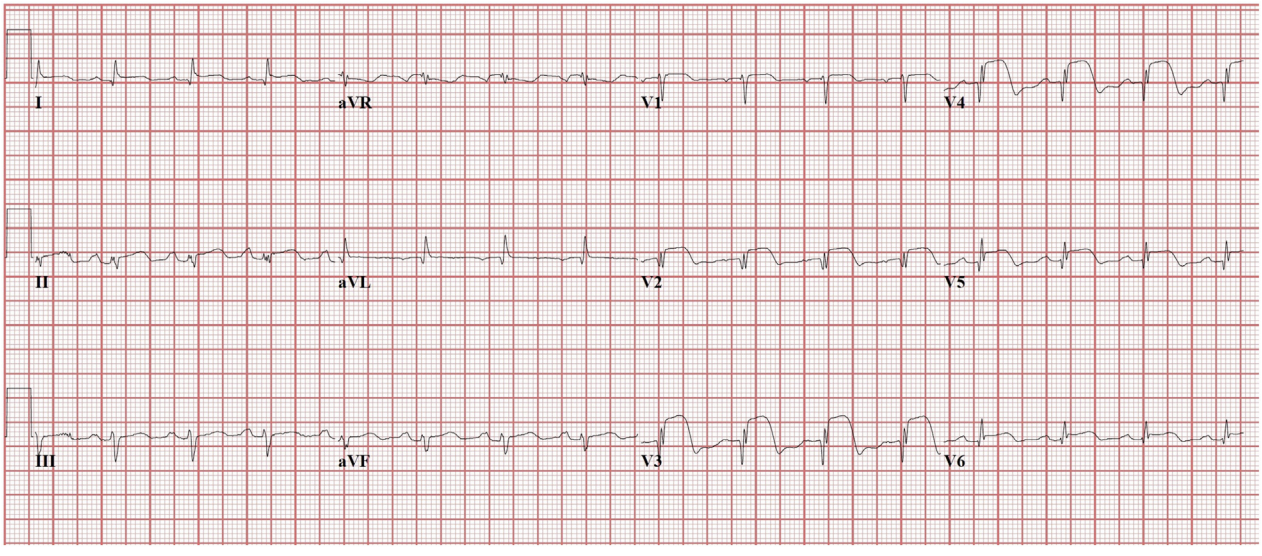
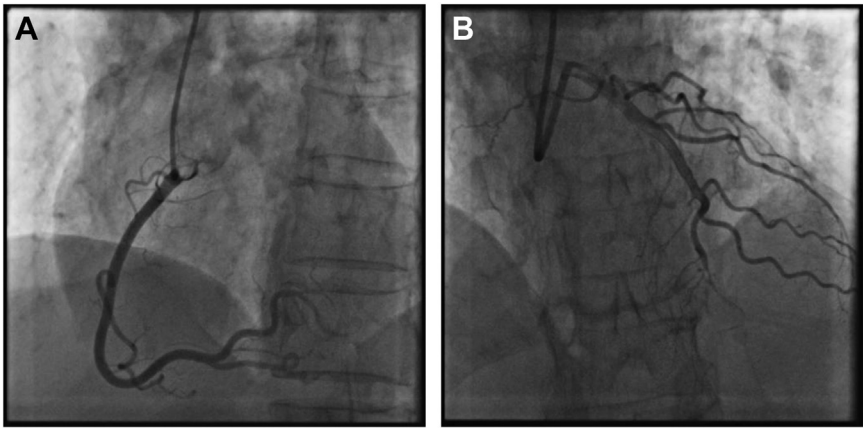


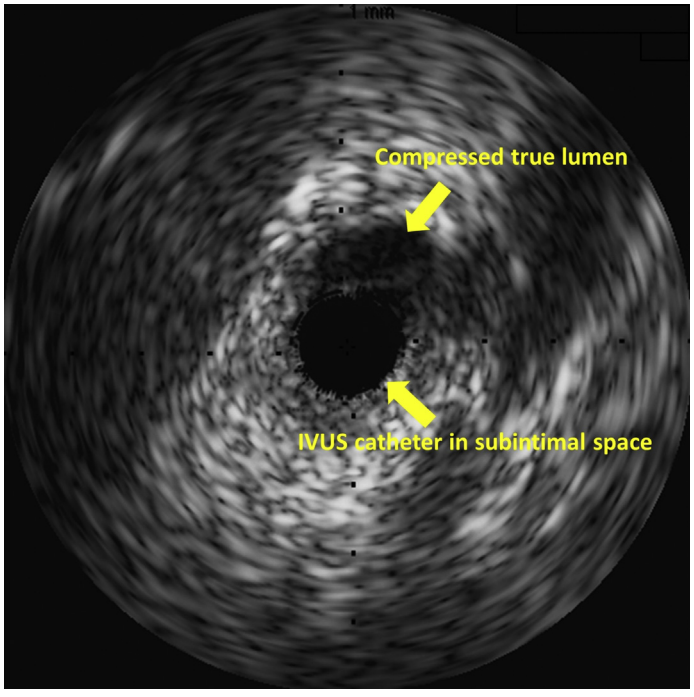
**FIGURE 2 Right and Left Coronary Angiography**




**(A)** Right coronary angiography. **(B)** Left coronary angiography.

than iatrogenic or associated with trauma (1). It affects women disproportionately (>90%) and generally occurs in patients without conventional cardiovascular risk factors, as was seen in the current case. Although it is often thought of as affecting younger patients, >30% of SCAD patients are ≥60 years of age (2). Because the presenting signs and symptoms of SCAD are identical to those of an acute coronary syndrome due to atherosclerotic disease, providers need to have a heightened index of suspicion based on the patient's demographics in order to make the diagnosis.

**FIGURE 3 IVUS Showing a Compressed True Lumen**




IVUS = intravascular ultrasonography.

SCAD is generally diagnosed by invasive coronary angiography and requires pattern recognition of the 3 main types of SCAD (3). Type 1 appears as a conventional coronary dissection with intimal staining and multiple lumens. Type 2, as seen in the present case, is the most common type and appears as a narrowed or occluded lumen due to compression from an intramural hematoma. Type 3 appears similar to an atherosclerotic lesion and requires intravascular imaging for confirmation. Because most dissections will heal on their own, conservative therapy is generally the preferred strategy. However, in high-risk patients such as those with ongoing ischemia and left main coronary artery dissection or those with hemodynamic instability, urgent revascularization with percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) is suggested (1). However, PCI for SCAD is associated with high rates of technical failure, including an inability to successfully wire the true lumen (1,2). In addition, hematoma propagation with ballooning and stenting is common. In a retrospective review of 189 patients, the procedural failure rate was as high as 53% in those managed with PCI, and there was an elevated risk of requiring emergency CABG (13%) primarily because of PCI failure (4). Given the challenges with conventional PCI for SCAD, alternative strategies are needed.

Antegrade dissection re-entry (ADR) is a technique that was initially developed for the treatment of chronic total occlusions (CTOs). There are wire-based re-entry techniques, such as STAR and mini-STAR, and a device-based technique using the StingRay balloon (5,6). The StingRay balloon is a flat balloon (shaped like a stingray) with exit ports on either side of the flat surface through which a wire can be advanced. When the balloon is positioned in the subintimal space, one port will be oriented toward the vessel wall, while the other port is oriented toward the true lumen. A penetrating wire is used to pop through the intima back into the true lumen. Previous reports have also successfully used this technique in the setting of myocardial infarction and complicated PCI due to occlusive iatrogenic dissection (7).

Because the StingRay balloon is an over-the-wire system, once the wire is removed, suction can be applied to withdraw intramural hematoma through the distal port. This technique (STRAW) can be done through any over-the-wire balloon or microcatheter, and in the case of SCAD, may improve coronary flow by reducing the size of the intramural hematoma and thus alleviating some of the luminal compression. In addition, decompressing the intramural hematoma improves the success rate of re-entry and may limit the hematoma propagation seen with stenting in SCAD. Using other known techniques to limit hematoma size, such as minimizing catheter injections and wire manipulations in the subintimal space, is also advised.

Overall, device-based ADR using the StingRay balloon is a more reliable and predictable technique than wire-based ADR, with the wire re-entering at the location of the device rather than at an unknown location downstream. This limits the length of the subintimal segment, which is preferred for limiting the loss of side branches. Furthermore, as was demonstrated, the StingRay balloon allows for STRAW to reduce the amount of intramural hematoma. Based on the present authors' experience with this case and, as is recommended with CTOs, use of the StingRay balloon is suggested as an initial strategy for subintimal re-entry with SCAD, and the STAR technique be used only in the case of StingRay failure.

## FOLLOW-UP

At 3 months, the patient denied anginal symptoms but noted residual shortness of breath, which was thought to be associated with the diagnosis of heart failure. Her LVEF had improved to 47%, but she

**FIGURE 4** Knuckle in the Subintimal Space Without Re-Entry

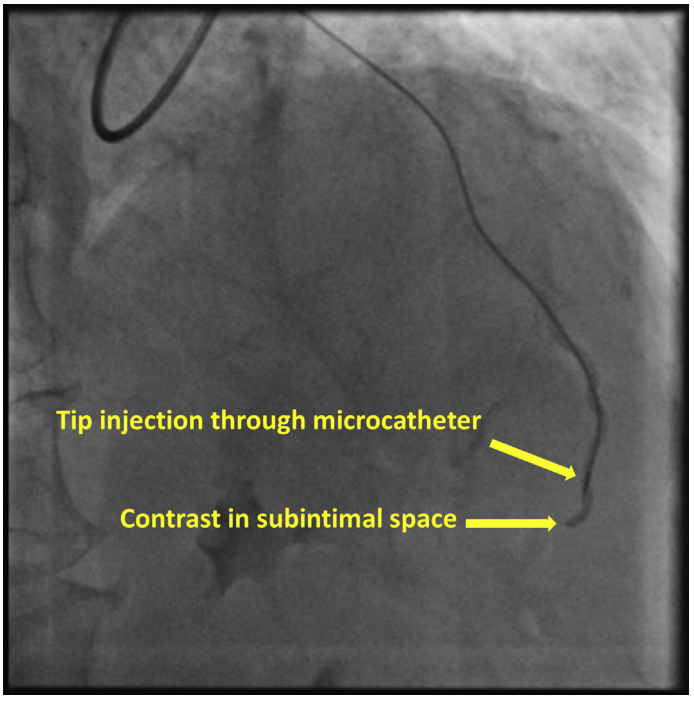
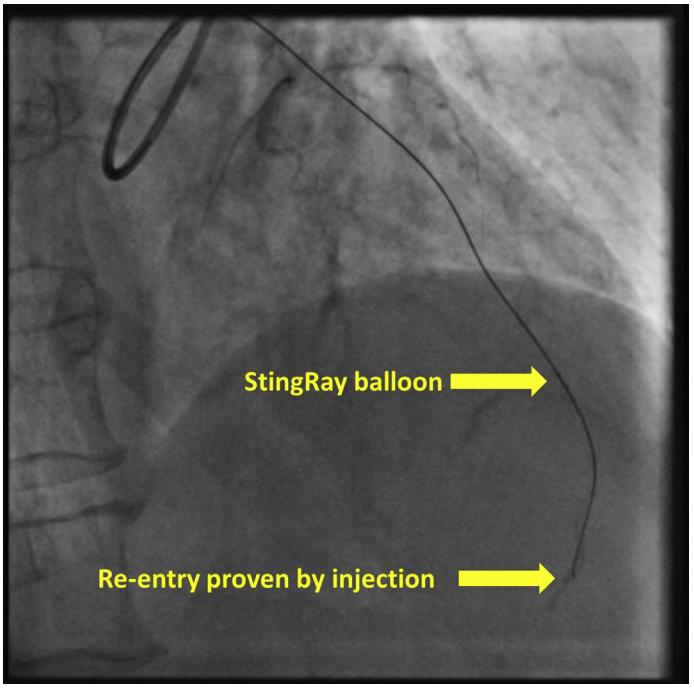



**FIGURE 5** StingRay Re-Entry Proven by Injection



continued to have apical akinesis with spontaneous echo contrast but no evidence of thrombus.

## CONCLUSIONS

Percutaneous management of SCAD has a high procedural failure rate compared with PCI for conventional atherosclerotic disease. Operators need to have a high index of suspicion when dealing with SCAD, so they are prepared for the commonly encountered challenges, such as difficulty in wiring the vessel. Intravascular imaging is vital to confirming wire location, and in the case of subintimal wiring, the present authors have demonstrated that ADR with the StingRay balloon can be used as a bailout strategy for successful revascularization.

**ADDRESS FOR CORRESPONDENCE:** Dr. Jennifer A. Tremmel, Division of Cardiovascular Medicine, Stanford School of Medicine, 300 Pasteur Drive, Room H2103, MC 5218, Stanford, California 94305. E-mail: jtremmel@stanford.edu.

## REFERENCES

**1.** Hayes SN, Kim ESH, Saw J, et al. Spontaneous coronary artery dissection: current state of the science: a scientific statement from the American Heart Association. Circulation 2018;137:e523–57.

**2.** Jacqueline S, Eve A, Tara S, et al. Spontaneous coronary artery dissection: association with predisposing arteriopathies and precipitating stressors and cardiovascular outcomes. Circ Cardiovasc Interv 2014;7:645–55.

**3.** Saw J. Coronary angiogram classification of spontaneous coronary artery dissection. Catheter Cardiovasc Interv 2014;84:1115–22.

**4.** Tweet MS, Eleid MF, Best PJM, et al. Spontaneous coronary artery dissection: revascularization versus conservative therapy. Circ Cardiovasc Interv 2014;7:777–86.

**5.** Walsh SJ, Cosgrove C, Spratt JC, Hanratty CG. A technical focus on antegrade dissection and re-entry for coronary chronic total occlusions: a practice update for 2019. Korean Circ J 2019;49:559–67.

**6.** Maeremans J, Dens J, Spratt JC, et al. Antegrade dissection and reentry as part of the hybrid chronic total occlusion revascularization strategy: a subanalysis of the RECHARGE registry (Registry of CrossBoss and Hybrid Procedures in France, the Netherlands, Belgium and United Kingdom). Circ Cardiovasc Interv 2017;10pii:e004791.

**7.** Azemi T, Fram DB, Hirst JA. Bailout antegrade coronary reentry with the StingRay balloon and guidewire in the setting of an acute myocardial infarction and cardiogenic shock. Catheter Cardiovasc Interv 2013;82:E211–4.

**KEY WORDS** percutaneous coronary intervention, spontaneous coronary artery dissection, STEMI

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