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Imaging and Case Report

Use of Subintimal Tracking and Re-entry Technique as a Bailout After Coronary Dissection

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Introduction

Subintimal tracking and re-entry (STAR), a technique initially described by Colombo et al,[1] is performed by rapidly advancing a polymer-jacketed guidewire through the occlusion segment of a chronic total occlusion (CTO) until it is forced back into the true lumen, often at a branch point. It is occasionally used during CTO intervention as a bailout technique but could also be useful during emergency situations such as iatrogenic vessel dissection. Herein, we report 2 cases where STAR was used as a bailout.

Case report

Case 1

A 70-year-old man with prior percutaneous coronary intervention (PCI) to the right coronary artery (RCA) presented with inferior ST-segment elevation myocardial infarction. Coronary angiography showed very late stent thrombosis of the proximal RCA (Figure 1A). After advancing a Sion Blue guidewire (Asahi Intecc) and balloon angioplasty, two 4.0 × 20-mm drug-eluting stents were installed. After stent deployment, there was a total occlusion of the posterior descending artery (PDA) due to thrombus migration. Another guidewire was advanced distally with some difficulty, but balloon angioplasty with a 2.0-mm balloon failed to restore flow (Figure 1B). The guidewire appeared to have entered the subintimal space. Strategy was switched to STAR after attempts to navigate the guidewire into the true lumen were unsuccessful. A knuckled Gladius Mongo guidewire (Asahi Intecc) was advanced distally using a microcatheter (Figure 1C), and re-entry was confirmed by intravascular ultrasound (IVUS). After balloon angioplasty, there was Thrombolysis in Myocardial Infarction (TIMI) 2 flow to the PDA and residual occlusion of the very distal segment of the PDA (Figure 1D). Chest pain improved, and ST elevation resolved immediately after STAR. An 8F intra-aortic balloon pump was placed, and the patient stabilized. The following day, there was TIMI 3 flow distally but with dissection of the proximal PDA (Figure 1E). The patient had an uneventful recovery, and follow-up coronary angiography at 4 weeks showed the distal PDA dissection has healed well (Figure 1F). At 1 year, he has returned to an active lifestyle free of angina.

Case 2

A 52-year-old woman presented with non-ST-segment elevation myocardial infarction. Coronary angiography revealed 95% lesion of the mid-RCA (Figure 1G). During advancement of a Power Turn guidewire (Abbott Vascular), a dissection occurred with an abrupt closure (Figure 1H). Several unsuccessful attempts to access the true lumen were made with a workhorse and polymer-jacketed guidewire. As the distal re-entry zone could not be visualized and the patient was not tolerating the ischemia, STAR was performed as described for case 1 (Figure 1I). After restoration of distal flow, successful PCI was performed with a 3.0 × 23-mm drug-eluting stent (Figure 1J, K). IVUS confirmed a short segment of subintimal tracking and re-entry proximal to the PDA/posterior lateral artery bifurcation (Figure 1L).

Discussion

Our cases highlight the usefulness of the STAR technique as a bailout strategy for acute vessel closure. If the guidewire is across the dissected segment at the time of dissection, flow can be restored by balloon angioplasty and stent deployment.[2] On the other hand, when the guidewire position is lost, the first step is to attempt to recross the dissected segment with a spring-coil guidewire to avoid extension of the dissection plane. If the operator cannot establish distal true lumen control, targeted re-entry with a Stingray balloon (Boston Scientific) or retrograde techniques can be employed. If these advanced CTO techniques are not possible, or too time-consuming, STAR can be considered.[2] Finally, when all approaches fail, coronary artery bypass grafting (CABG) or mechanical circulatory

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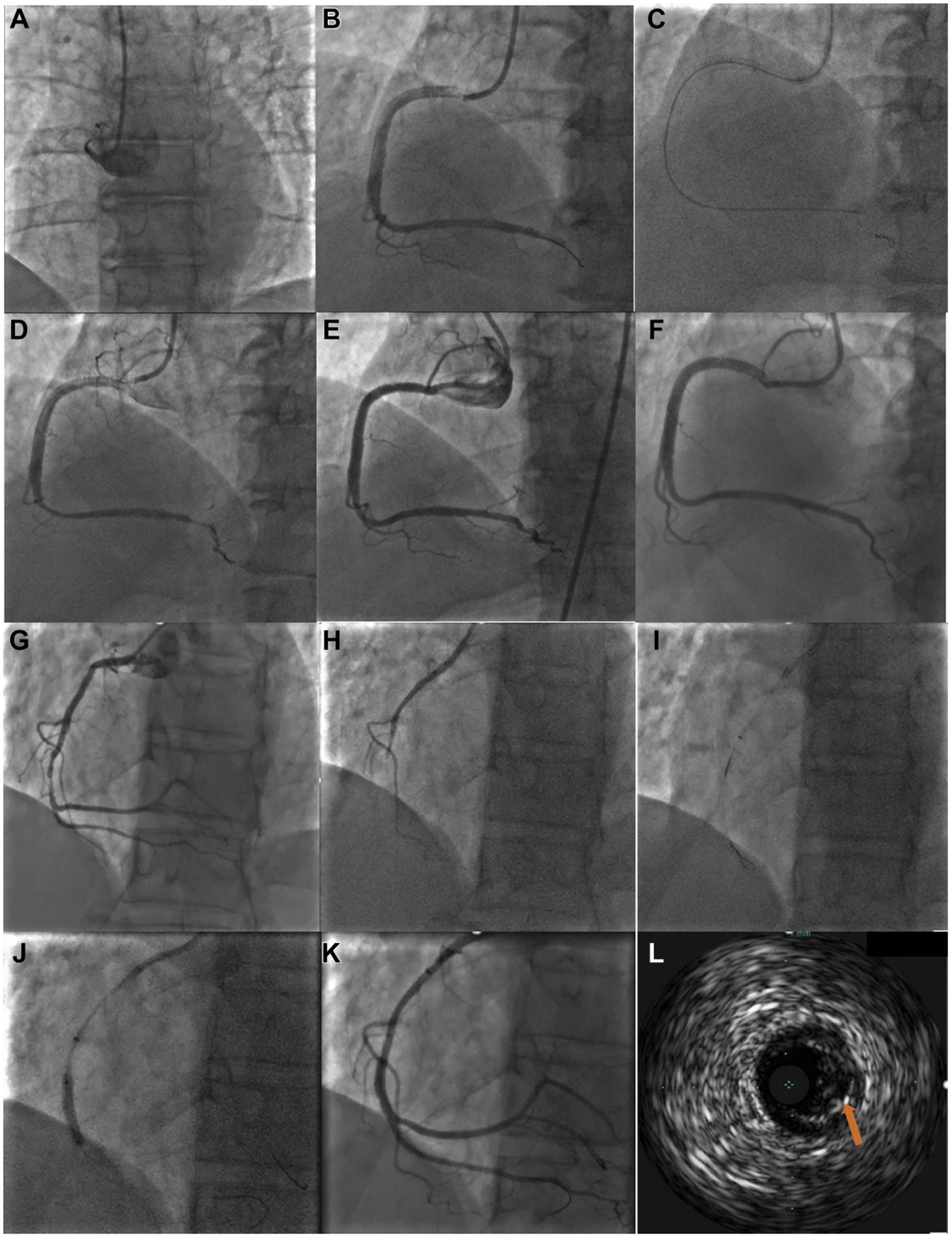

Figure 1. Angiography and IVUS findings for cases 1 and 2. (**A**) Initial coronary angiography with acute total occlusion of the proximal RCA. (**B**) After PCI to the proximal RCA, there is poor distal flow to the PDA with a vessel dissection. (**C**) STAR was performed to the PDA. (**D**) Angiographic result after STAR. (**E**) Repeat coronary angiography after STAR on the following day. Note the distal PDA with a dissection flap but with better distal flow. (**F**) Relook coronary angiography 4 weeks later shows the dissection flap in the PDA has healed. (**G**) Initial angiography with culprit lesion of the mid-RCA. (**H**) Acute vessel closure due to vessel dissection. (**I**) STAR was performed using a polymer-jacketed guidewire. (**J**) A 3.0 × 23-mm drug-eluting stent was placed after confirming re-entry proximal to the bifurcation by IVUS. (**K**) Final result after PCI. (**L**) IVUS images suggest very short subintimal course of the guidewire (orange arrow, true lumen). IVUS, intravascular ultrasound; PCI, percutaneous coronary intervention; PDA, posterior descending artery; RCA, right coronary artery; STAR, subintimal tracking and re-entry.

support can be considered.[2] In our cases, the STAR technique was selected as it was the quickest to restore flow.

With case 1, we are the first to report a complete angiographic follow-up at 1 and 30 days after the initial STAR attempt. Compared to immediately after STAR, more septal branches and myocardial blush were visualized at 1 day but with a clear angiographic dissection flap, which also resolved at 30-day follow-up.

Staged PCI after STAR has become the default after unsuccessful CTO PCI, as a recent study reported higher patency rates than a traditional STAR[3]; however, there is likely a subgroup where the PCI can be

performed without staging. Although one limitation of STAR is uncontrolled re-entry, the guidewire can occasionally re-enter proximal to a major side branch as in case 2. The use of IVUS to identify the re-entry point is of paramount importance to supplement the angiographic identification of re-entry. If one inadvertently stents across a major branch after STAR and the wire entered the true lumen after the branch, the stent will effectively seal the branch by pinning the dissection flap over the origin of the branch, making rescuing the branch very difficult. Therefore, if the re-entry point is in doubt, the safer approach is to stage the stenting.

Some clinical questions remain to be addressed. First, the optimal timing of the staged PCI is unknown. Second, although it has been previously reported that subintimal plaque modification can lead to improved quality of life[4] and greater success of repeat CTO PCI,[5] whether STAR can improve the quality of life has not been studied. Third, the vessel healing pattern and predicators of vessel patency at the time of staged PCI have not been reported. These clinical questions will be assessed in the currently ongoing STAR study (NCT05089864). Finally, the STAR technique has limited utility in left anterior decending artery occlusion as it may compromise the flow to multiple septal perforators and diagonal branches. If the patient is not acutely ill, referral for a targeted re-entry or consideration of CABG may be more appropriate.

Conclusion

STAR can be a useful bailout technique for vessel dissection during non-CTO PCI when distal vessel flow cannot be re-established before considering emergency CABG, mechanical circulatory support, or conservative management.

Declaration of competing interest

Dr Hirai has disclosed speaking fees and consultation fees from Abiomed, Siemens Healthineers, Asahi Intecc, and Abbott Vascular. Dr Grantham has disclosed speaking fees, honoraria, and consulting fees from Siemens Healthineers, Boston Scientific, Abbott Vascular, Abiomed, and Asahi Intecc and institutional grant support from Boston Scientific. Dr Spaedy has disclosed speaking fees and honoraria from Boston Scientific and Abbott Vascular. Dr Mansour has no conflict of interest to report.

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