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Case Reports

Management of Guidewire Entrapment and Fracture During Percutaneous Coronary Intervention: When All Bailout Techniques Fail!

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Abstract

A 55-year-old man presented with chest pain and was diagnosed with non–ST-segment elevation myocardial infarction. Coronary angiography revealed a 95% eccentric lesion in the mid-right coronary artery. After 3 intracoronary stents were placed, the guidewire became entrapped in 1 of the stents; multiple attempts at retrieval were unsuccessful. Ultimately, the guidewire fractured, and a coronary artery bypass graft surgery was performed to remove the guidewire fragments. This report reviews the procedural steps for wire retrieval that are critical for operators to avoid coronary artery bypass surgery.

Keywords: Intraoperative complications; percutaneous coronary intervention; angioplasty, balloon, coronary

Introduction

Guidewire entrapment and fracture is an infrequent but potentially devastating complication of percutaneous coronary intervention.[1] In these cases, percutaneous retrieval should be attempted before surgical intervention. Different techniques have been described, with varying success,[2] but there is no management guideline for this scenario. This report describes an experience with guidewire entrapment where multiple attempts at retrieval were unsuccessful, and the guidewire eventually fractured. The risk factors for this complication are reviewed, and steps for percutaneous retrieval of entrapped or fractured guidewires are provided. Operators should be mindful that guidewire fracture may be associated with unravelling of the radiolucent inner core, which cannot be seen on fluoroscopy. Clinicians must ascertain the length of the guidewire fragment using other diagnostic techniques before deciding on a plan for further management.

Case Report

A 55-year-old man with a history of hypertension, type 2 diabetes mellitus, and hyperlipidemia presented with midsternal chest pain and shortness of breath. His physical examination was unremarkable, but initial electrocardiography showed T-wave inversions in lead III. Subsequent electrocardiograms showed development of T-wave inversions and Q waves in lead aVF. His troponin I level rose from 0.421 to 1.530 ng/mL, and he was diagnosed with non–ST-segment elevation myocardial infarction.

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Technique

Urgent cardiac catheterization was performed. Angiography revealed an anomalous left main coronary artery originating from the right coronary sinus (Fig. 1). The mid-right coronary artery (mid-RCA) was moderately calcified with a 95% eccentric and thrombotic lesion (Fig. 1). A 6F JR4 guiding catheter (Cordis) was used to intubate the right coronary ostium. A 190-cm Runthrough guidewire (Terumo Corporation) was advanced into the distal RCA without difficulty, and a 3.5 × 16-mm Synergy everolimus-eluting stent (EES) (Boston Scientific) was deployed at the mid-RCA lesion. Angiography then showed a proximal dissection and a small distal-edge dissection in the RCA (Fig. 2). The proximal portion of the RCA was stented, overlapping the first stent with a 3.5 × 8-mm Synergy EES, and the distal dissection was stented with a 3.0 × 8-mm Synergy EES. There was no loss of wire position during these procedures; however, the guidewire became slightly angulated in the distal segment. Subsequent angiography showed grade 3 Thrombolysis in Myocardial Infarction flow throughout the RCA with no evidence of dissection (Fig. 3).

As the guidewire was being removed, its tip became entrapped in the distal stent, which accordioned back into the mid-RCA stent (Fig. 4). A number of techniques to retrieve the guidewire were attempted. First, intracoronary nitroglycerin was administered. Second, a 1.5-mm rapid exchange balloon was advanced over the entrapped guidewire into the distal segment, and low-pressure inflation was attempted to release the wire (Fig. 5). Third, a second Runthrough guidewire (300 cm) was advanced into the distal RCA (Fig. 6), and multiple attempts to release the entrapped guidewire were made using the rapid exchange balloon over both the short and long guidewires. When these attempts were unsuccessful, intravascular ultrasonography (IVUS) was employed to locate the exact position of the entrapped wire; however, the IVUS catheter could not be advanced deep enough for accurate visualization because of the narrow RCA lumen in the area of the accordioned stent.

An attempt was then made to twist the guidewire out of the mid-RCA using mild back-tension. During this maneuver, the distal tip of the guidewire broke. The longer portion of the wire was removed, but angiography revealed a retained fragment of the guidewire tip within

Abbreviations and Acronyms

EES	everolimus-eluting stent
IVUS	intravascular ultrasonography
RCA	right coronary artery

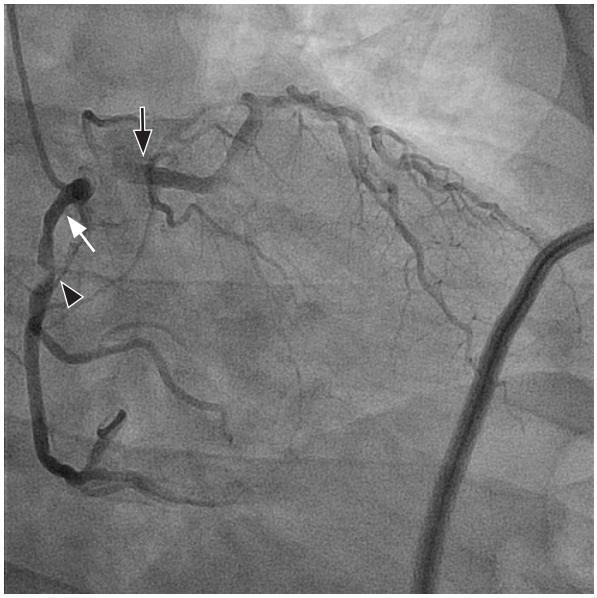

Fig. 1 Coronary angiography shows the left main coronary artery (black arrow) and the right coronary artery (white arrow) both originating from the right coronary sinus; there is a 95% thrombotic lesion in the mid-right coronary artery (arrowhead).

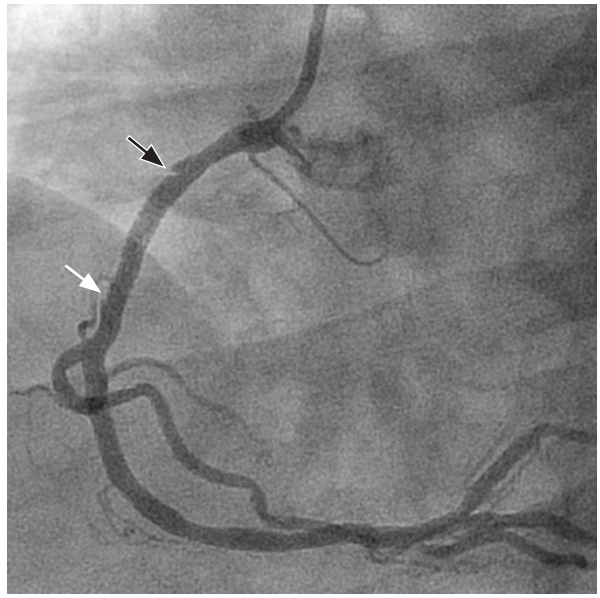

Fig. 2 Coronary angiography shows a proximal RCA dissection (black arrow) and a distal RCA dissection (white arrow) after stent deployment.

RCA, right coronary artery.

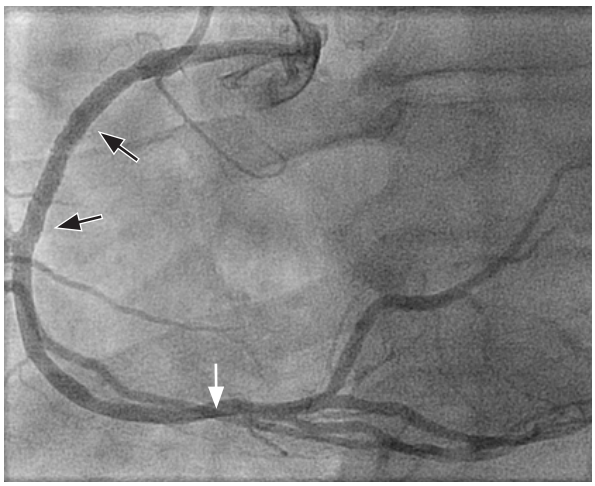

Fig. 3 Coronary angiography shows TIMI grade 3 flow throughout the RCA (black arrows) without dissection after stent deployment in the proximal and distal RCA; the guidewire is seen in the distal RCA (white arrow).

RCA, right coronary artery; TIMI, Thrombolysis in Myocardial Infarction.

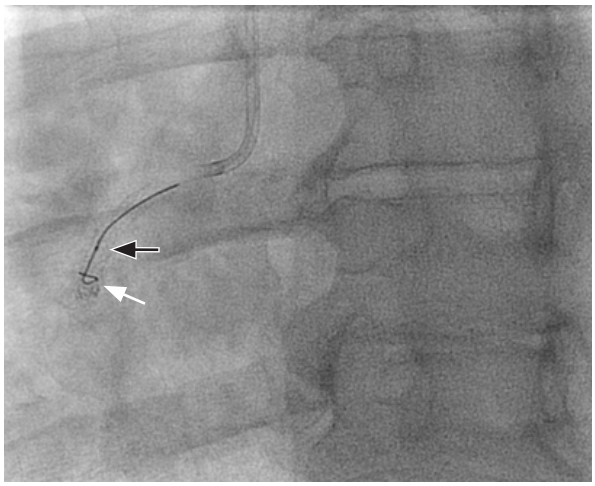

Fig. 5 Coronary angiography shows an attempt to release the guidewire (white arrow) by passing and inflating a 1.5-mm rapid exchange balloon (black arrow) over it.

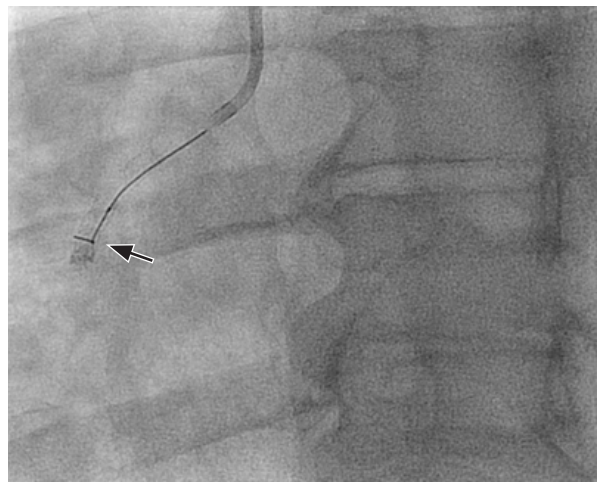

Fig. 4 Coronary angiography shows the entrapped guidewire tip in the mid-RCA stent (arrow).

RCA, right coronary artery.

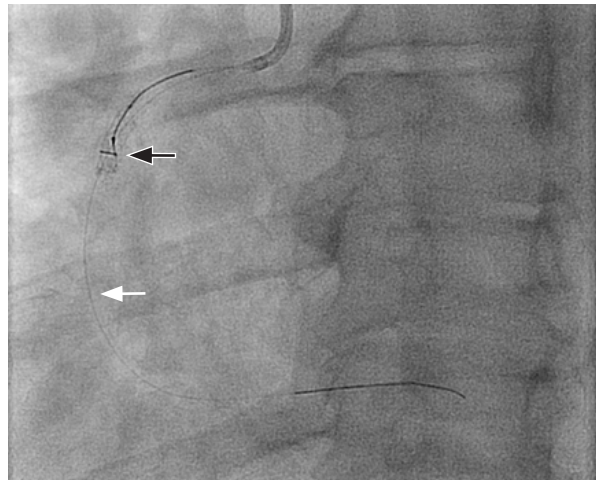

Fig. 6 Coronary angiography shows an attempt to release the entrapped guidewire tip (black arrow) in the mid-RCA by passing another wire distally (white arrow) and inflating the second balloon.

RCA, right coronary artery.

the accordioned RCA stent. An area of 30% to 40% residual stenosis was noted distally, where the distal stent had originally been placed (Fig. 7). The proximal portion of the RCA at the target lesion had minimal residual stenosis, and there was grade 3 Thrombolysis in Myocardial Infarction flow throughout the RCA. The patient was transferred to the cardiac intensive care unit on an eptifibatide drip.

To understand how much of the guidewire was retained (ie, not visualized by angiography), computed tomography angiography was obtained to better delineate the coronary anatomy and reveal the radiolucent inner core of the guidewire. The retained wire was attached to the stent within the mid-RCA and extended in the cephalad direction through the aortic root, brachiocephalic artery, and right subclavian artery to terminate at the junction of the right axillary and brachial arteries (Fig. 8). The lumen of the RCA was severely narrowed in the area of the accordioned stent, and the anomalous left main coronary artery was noted to follow a subpulmonic course. At that point, the heart team members decided to perform surgical removal of the retained guidewire fragment.

The patient subsequently underwent single-vessel coronary artery bypass graft surgery, using the right internal mammary artery to anastomose to the distal RCA. The intra-arterial RCA stent and retained wire fragment were removed (Fig. 9 and Fig. 10). The patient had an uneventful postoperative course and was discharged 4 days after surgery. When he was seen for follow up after 1 month, he reported no concerning symptoms.

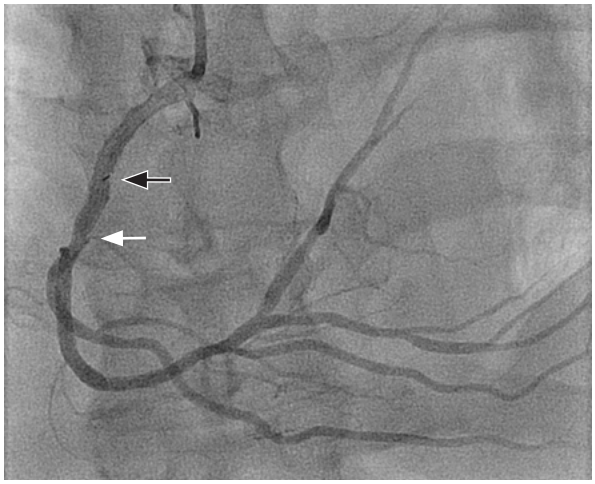

Fig. 7 Coronary angiography shows the retained guidewire tip (black arrow) in the mid-RCA and 30% to 40% residual stenosis (white arrow) in the distal RCA.

RCA, right coronary artery.

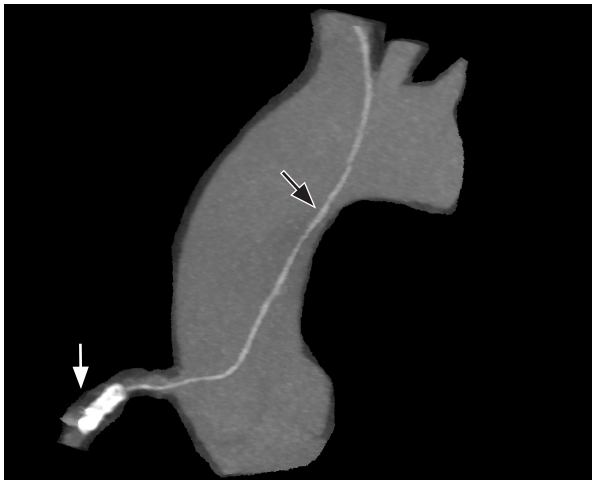

Fig. 8 A reconstructed coronary computed tomography angiography image shows the mid-RCA stent (white arrow) with the entrapped guidewire fragment coursing cephalad (black arrow) through the aorta and brachiocephalic artery.

RCA, right coronary artery.

Discussion

This report describes an experience with guidewire entrapment and fracture occurring after proximal- and distal-edge RCA dissections were likely caused by insertion of an oversized stent. When 2 more stents were deployed to manage these dissections, the guidewire became entrapped in the distal stent during withdrawal.

Guidewire retention is an infrequent complication of percutaneous coronary intervention. In 1987, Hartzler et al[1] reported an incidence of 0.1% to 0.2% in a series of 5,400 consecutive patients. More recently, Iturbe et al[3] reported an incidence of 0.08% in 2,238 consecutive patients. In the patient featured in this report, slight angulation of the distal segment of the guidewire and moderate calcification of the RCA lesion likely contributed to entrapment of the guidewire in the stent strut, a situation that was previously reported.[4] Strategies to prevent guidewire entrapment include maintaining proper wire positioning, avoiding excess angulation in the wire, and maintaining backward traction during stent advancement.[4] Wire positioning can be confirmed

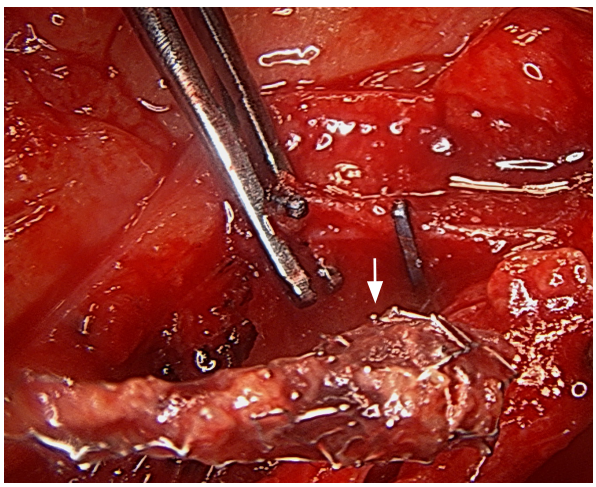

Fig. 9 Intraoperative photography shows surgical extraction of the mid-RCA stent (arrow).

RCA, right coronary artery.

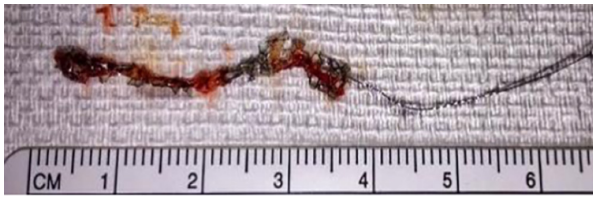

Fig. 10 Postoperative photography shows the surgically extracted, 32-cm stent with attached guidewire fragment.

using IVUS. Guidewire entrapment, overrotation, and forceful guidewire traction have been implicated in fracture.[5] The attempt to remove the entrapped guidewire by twisting with mild back-tension in this patient could have increased the chance of fracture. Removal of the radiopaque polymer coating precluded visualization of the retained guidewire core on fluoroscopy; this core was eventually visualized on computed tomography angiography, but IVUS can also be used to detect a retained guidewire core.[6] Detachment of the hydrophilic tip and circumcision of the polymer coating have been reported with polymer-coated guidewires.[7]

Retained guidewire fragments in the coronary tree can lead to life-threatening complications such as perforation, dissection, vessel occlusion, thrombosis, and embolism[5]; hence, attempts at retrieval are warranted. Percutaneous removal should be attempted first; many techniques have been successfully employed.[2] A guide catheter can be wedged over the entrapped guidewire, followed by balloon inflation at the terminal part, thus trapping the wire. The whole system can then be retracted together. Operators can advance another guidewire and attempt to disentangle the entrapped guidewire by balloon inflation. A snare loop can be used to grasp the fragment, if a snare of appropriate size is available. Retrieval can also be attempted by twisting 2 or 3 guidewires around the retained fragment to trap it and then retracting all wires together.

Although percutaneous removal is the preferred option, extensive manipulation within the coronary tree can lead to catastrophic complications, including coronary dissection, thrombosis, myocardial ischemia from coronary obstruction, or embolization of the guidewire fragment.[2] Therefore, prolonged attempts at percutaneous retrieval should be avoided. In selected patients, guidewire fragments may be left in situ, particularly if they are entrapped in the distal coronary branches or embedded in chronic total occlusions and chances of successful removal are slim. If the fragment is small enough, a stent can be used to completely cover it and compress it against the vessel wall.[1,2] This approach would not have been ideal in the patient in this report because of the location and the length of the guidewire remnant.

If the wire fragment cannot be left in situ and attempts at percutaneous retrieval fail, surgical intervention is the last resort. Surgical extraction was required in 43% of the cases reviewed by Al-Moghairi et al.[2] Bypass grafting, as performed for the patient in this report, is required in most instances.

TABLE I. Steps for Retrieving an Entrapped Guidewire During PCI

Step	Description
1	Avoid excessive force on the guidewire
2	Administer an intracoronary vasodilator
3	Guide an intubation catheter over the guidewire and inflate the balloon
4	Insert a second guidewire and inflate a balloon to trap the wire; consider IVUS
5	Insert a snare loop
6	Use a double- or triple-wire technique
7	Completely cover the entrapped wire with a new stent (if feasible)
8	Perform surgical intervention to retrieve the wire fragments

IVUS, intravascular ultrasound; PCI, percutaneous coronary intervention.

Conclusion

Guidewire entrapment and fracture is a rare but potentially life-threatening complication of percutaneous revascularization.[1,3] Initial steps to retrieve an entrapped guidewire fragment may include administering intracoronary vasodilators with gentle attempts to release the fragment, but more complex percutaneous retrieval techniques should be attempted if the initial approach fails. Table I shows steps that can be taken for percutaneous retrieval of entrapped guidewire fragments. Operators should attempt these techniques before considering surgical intervention.

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