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Retrieval Techniques for Managing Flexible Intracoronary Stent Misplacement

Karl W. Foster-Smith, MB, BSc, MRCPI, Kirk N. Garratt, MD, Stuart T. Higano, MD, and David R. Holmes, Jr., MD

With the increasing use of flexible intracoronary stents, the likelihood of complications, including stent misplacement, will tend to rise. We describe the successful use of three commercially available retrieval devices: the nitinol gooseneck snare, the biliary forceps, and the multipurpose basket. We recommend the availability of these devices to operators involved in intracoronary stent placement.

Key words: angioplasty, atherosclerosis, endovascular prosthesis

INTRODUCTION

Intracoronary stents are being used with increasing frequency not only as bailout devices to treat complications of percutaneous transluminal coronary angioplasty (PTCA) or suboptimal dilatation result, but also for treatment or prevention of restenosis. They require meticulous attention to procedural and periprocedural details and medications to minimize complications. Failure of stent delivery or stent embolization has been reported, particularly for stents that do not have sheath delivery systems [1–9]. Stent embolization, which usually occurs in the systemic circulation, is the result of being unable to cross the lesion; when the stent and balloon are being withdrawn, the stent can be stripped off the balloon. As the frequency of centers implanting stents increases, particularly during the early learning curve phase, there may be increased need for stent removal. During 193 attempted stent placements in the last 4 years, we have experienced 4 cases of stent misplacement in 3 patients. We describe the retrieval techniques used to remove these 4 flexible intracoronary stents.

From the Division of Cardiovascular Diseases and Internal Medicine, Mayo Clinic and Mayo Foundation, Rochester, Minnesota.

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Address reprint requests to Dr. Kirk N. Garratt, Division of Cardiovascular Diseases, Mayo Clinic, Rochester, MN 55905.

CASE #1

A 69-year-old man with recurrent angina, postcoronary artery bypass surgery, and restenosis following 3 recent percutaneous transluminal coronary angioplasty (PTCA) procedures was scheduled for Wiktor stent (Medtronic, Minneapolis, MN) placement to a proximal right coronary artery vein graft lesion. An 8 French right coronary bypass Triguide (SciMed Life Systems, Minneapolis, MN) was used to engage the vein graft ostium. It was crossed with a 0.018″ intermediate guidewire and a 3.5 mm × 15 mm Wiktor stent and balloon. Considerable difficulty was encountered in attempting to cross the lesion, causing the proximal stent loops to be compressed toward the center of the delivery balloon. The stent could not be withdrawn into the guide catheter due to splaying of the proximal wire loops, so the entire system was pulled back into the right iliac artery. The guide catheter was removed through the hemostatic sheath. A 4 French nitinol gooseneck snare (Microvena Corp., Vadnais Heights, MN) with a 15 mm loop diameter and length of 120 cm (Fig. 1A) was passed through the femoral sheath alongside the delivery balloon catheter and positioned above the guidewire with the snare open (Fig. 2a). The guidewire was manipulated through the loop (Fig. 2b). The snare was then withdrawn to the level of the stent and balloon and tightened. The stent, balloon catheter, and snare were all removed as a unit through the hemostatic sheath (Fig. 2c).

The graft stenosis was crossed again with a 0.018 mm intermediate wire and a 3.5 mm Mirage balloon (SciMed Life Systems). Two inflations were performed to a maximum of 12 atmospheres for 2.5 min. A 3.5 mm × 15 mm Wiktor stent was advanced across the lesion and expanded with 6 atmospheres for 90 sec. The proximal portion of the stent failed to fully expand despite repeated inflations. The Mirage balloon was exchanged for a 3.5 mm Force system (USCI-Bard, Billerica, MA). One inflation at 19 atmospheres was performed for 2.5 min. Partial unraveling of the proximal part of the stent occurred on withdrawal of the balloon, resulting in an elongated portion of wire extending out of the vein graft ostium and into the ascending aorta (Fig. 3a). Because this configuration posed a risk of thrombus formation and embolization, a decision was made to remove the stent. The coronary wire and deployment balloon were removed. Using a biliary forceps (Medi-Tech, Watertown, MA) (Fig. 1B) (closed diameter 1.6 mm, opened diameter 25 mm, length 120 cm), the proximal end of the

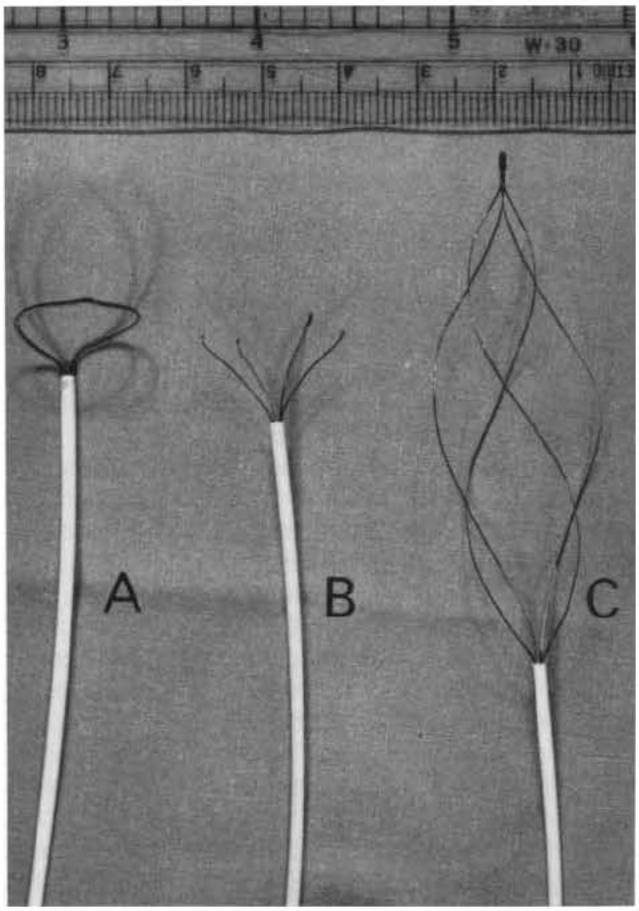

Fig. 1. (A) The nitinol gooseneck snare, (B) biliary forceps, and (C) multipurpose basket.

stent was grasped and slowly drawn back into the guide catheter (Fig. 3b). The single tantalum filament gradually uncoiled, and the unwinding stent wire came free of the vein graft. Stent release did not result in any angiographic evidence of disruption, excoriation, thrombosis or other trauma (Fig. 3c). After stent recovery, the stenosis was estimated as 40%; in view of the refractory nature of the lesion to high-pressure dilatation, this residual stenosis was accepted and no further attempts were made to place a stent.

CASE #2

A 65-year-old white female was referred to Mayo Clinic with recurrent angina and recurrence of a complex left main coronary artery lesion. Her past medical history included two coronary artery bypass operations to her left coronary artery system and restenosis of a complex left main coronary artery lesion, which had 4 months previously been treated with directional laser angioplasty. The sequential left internal mammary artery graft

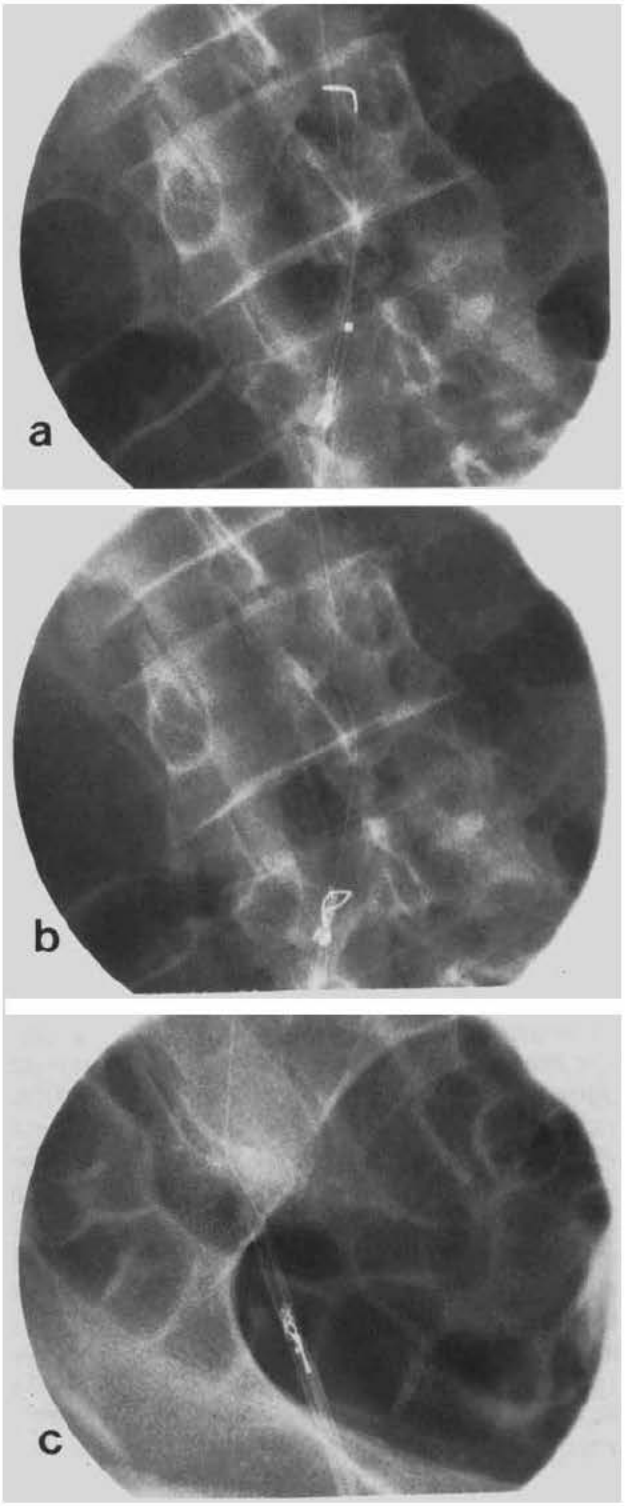

Fig. 2. (a) After unsuccessful stent placement attempt, equipment is withdrawn to right iliac artery. Nitinol gooseneck snare is looped over the distal end of coronary guidewire. (b) Nitinol gooseneck is positioned over stent. (c) Gooseneck snare is tightened over stent and withdrawn through 8F vascular sheath.

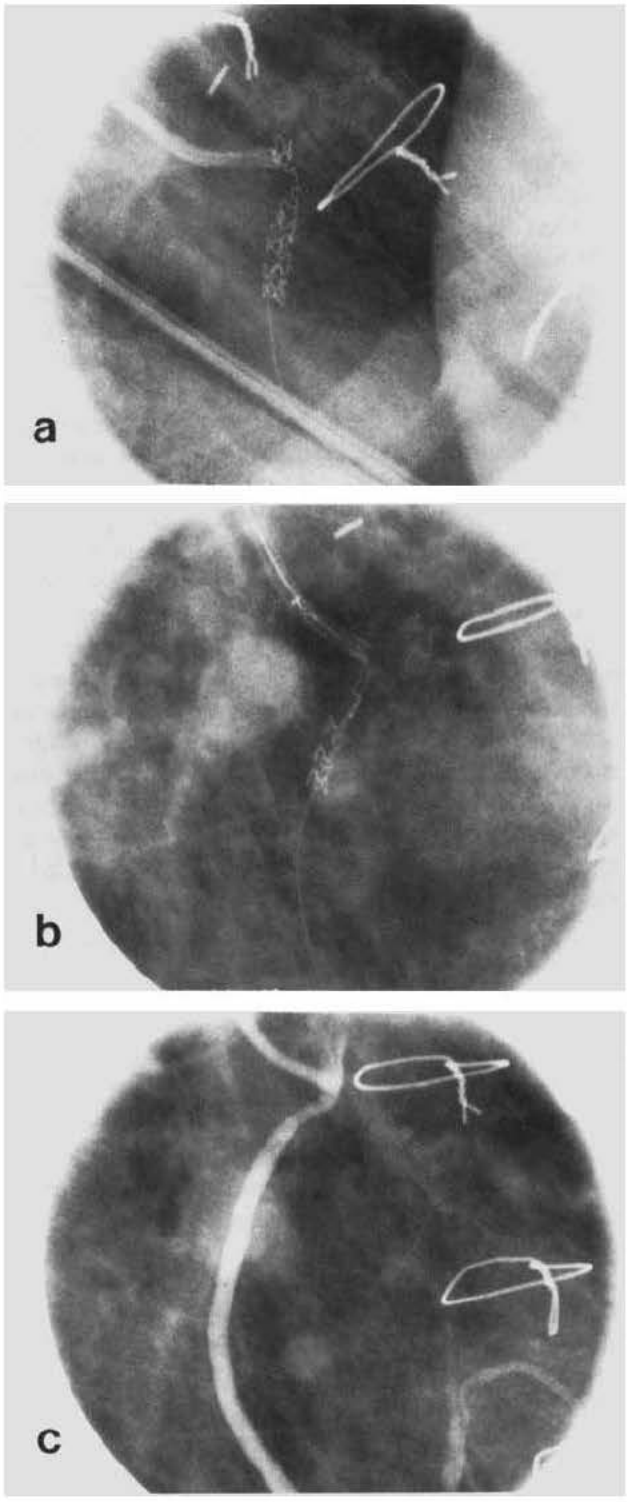

Fig. 3. (a) After placement, the proximal portion of stent is partially unraveled and extends into aortic root. (b) After capturing the end of the stent wire with a biliary forceps, the stent is removed. The stent uncoils as it is withdrawn into the guide catheter. (c) No evidence of trauma to proximal vein graft after stent removal.

to the first diagonal and left anterior descending arteries was patent. Repeat directional laser angioplasty was recommended to the patient. The left coronary artery was engaged with an 8-F left Judkins catheter (Cordis, Miami, FL). After 4 passes with a 1.8 mm eccentric excimer laser fiber system (AIS, Irvine, CA), considerable improvement was seen, but a significant residual stenosis remained. The laser catheter was replaced by a 3.5 mm Force balloon which ruptured during the second inflation at 20 atmospheres, resulting in a localized dissection of the left main coronary artery. Additional balloon angioplasty did not resolve the dissection. Consequently, a decision was made to attempt placement of a 3.5 mm × 20 mm Gianturco-Roubin stent (Cook, Bloomington, IN). The stent could not cross the stenosis due to calcific disease, and during the process the stent became dislodged from its deployment balloon (Fig. 4a). The cylindrical geometry of the stent was not disrupted and the distal end of the guidewire remained in place in the left anterior descending artery, so the stent was trapped between the distal end of the guide catheter and the left main ostium with the coronary guidewire running through its center. The deployment balloon catheter was removed. In an attempt to capture the stent, a 3.0 mm Mirage balloon catheter was passed through the stent and inflated to 5 atmospheres. However, the stent could not be withdrawn into the guide catheter in its expanded form.

The stent, with its supporting Mirage balloon, and the guide catheter were withdrawn down to the iliac artery, the guidewire still being in position. On attempting to again withdraw the stent into the guide, it was dislodged from the balloon catheter. The balloon catheter was withdrawn. A multipurpose basket (Medi-Tech) (Fig. 1C) (closed diameter 1.6 mm, open diameter 20 mm, length 120 cm) was passed through the guide catheter. This snared the distal coronary wire preventing stent deployment into the circulation (Fig. 4b). All were removed as a unit through the femoral sheath. The postdilatation left main stenosis was measured at 50%. No further attempts were made to place a stent.

CASE #3

A 53-year-old white male was transferred to Mayo Clinic with a history of unstable angina culminating in acute anterior myocardial infarction, which was managed medically. Five days later he suffered recurrent anterior myocardial infarction. Emergency coronary angiography revealed a 99% occluded proximal left anterior descending coronary artery. Balloon dilatation of this lesion was successfully performed, leaving a 30% residual stenosis. The patient received high dose heparin,

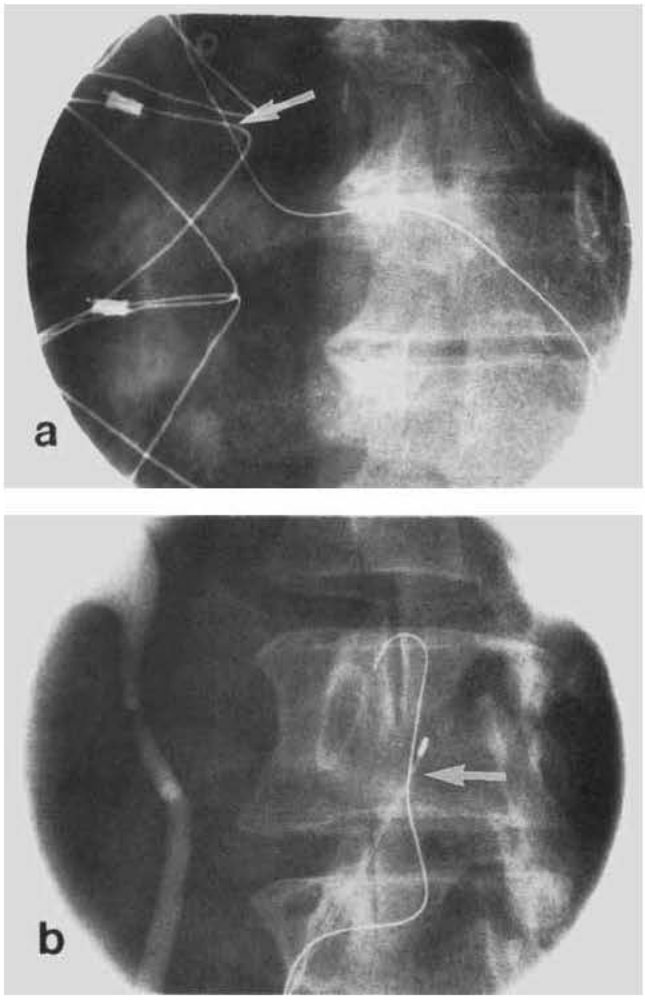

Fig. 4. (a) After unsuccessful attempted stent placement, Gianturco-Roubin stent is stripped from deployment balloon but remains aligned with coronary guidewire (arrow). (b) The coronary guidewire is grasped (at arrow) with a multipurpose basket distal to the stent; the basket is closed over the guidewire by retracting the basket into a delivery sheath. The stent and guidewire are removed by withdrawing the basket.

aspirin, and nitrates during the procedure and was returned to the Coronary Care Unit pain free.

He developed recurrent chest pain and electrocardiographic abnormalities 1 hr later and was returned to the catheterization laboratory. Coronary angiography revealed an occluded proximal left anterior descending artery at the site of the previous PTCA. A 0.014″ hi-torque floppy guidewire was advanced through the occlusion. A 3.5 mm Stack autoperfusion balloon (ACS, Temecula, CA) was positioned across the lesion and inflated to 4 atmospheres for 15 min. There was marked improvement in the appearance of the lesion initially. However, subtotal reocclusion developed within 10 min. A decision to proceed with coronary stent placement was made. A 3.5 × 12 mm Gianturco-Roubin intracoronary stent was advanced through an 8 French Judkins left Bright Tip guide catheter (Cordis). The procedure was complicated by inadvertent placement of the distal coronary wire in the first diagonal branch, which resulted in inability to cross the lesion with the stent. The stent delivery balloon was retracted to permit redirection of the guidewire into the distal left anterior descending artery. Upon retraction the stent was displaced toward the distal end of its deployment balloon. The guide catheter, deployment balloon and stent were withdrawn (Fig. 5a) to below the level of the renal arteries while still maintaining the position of the coronary wire in the left coronary artery.

An attempt was made to retract the deployment balloon and stent into the guide catheter, but this caused the stent to come free of the balloon. The position of the collapsed stent was stabilized by the coronary guidewire, which was still positioned in the diagonal branch. The deployment balloon was removed and a biliary forceps was advanced (Fig. 5b). The forceps were opened and the edge of the stent was grasped without also capturing the coronary guidewire. The forceps and stent were removed (Fig. 5c). The guide catheter was repositioned and the coronary wire placed in the distal left anterior descending. A Gianturco-Roubin 3.5 × 12 mm stent was advanced and seated easily across the lesion. After a single inflation to 6 atmospheres for 2 min, the stent was well deployed. The residual stenosis was estimated at 20%.

DISCUSSION

Although stent embolization is not a frequent event, it is reported to occur in up to 8% of cases in the current literature [1–9]. Fortunately, the majority of cases do not result in clinical sequelae. However, the potential for permanent or life-threatening complications (such as stent embolization to the cerebrovascular circulation) remains.

The case reports cited here demonstrate the use of three different devices to retrieve flexible intravascular stents. The first, the nitinol gooseneck snare, has been used in the retrieval of a ventriculo-atrial shunt tip, guidewires or a Wallstent from the circulation and also in the removal of ureteric stents [10,11]. This snare has two advantages. First, the loop is at a right angle to the catheter, making intravascular snaring easier than with straight devices. Second, the loop is made from nickel-titanium, increasing its tensile strength and reducing the chance of cable fracture.

The second device described was the biliary forceps. This instrument has the advantage of retrieving stents without loss of coronary wire position unlike the other

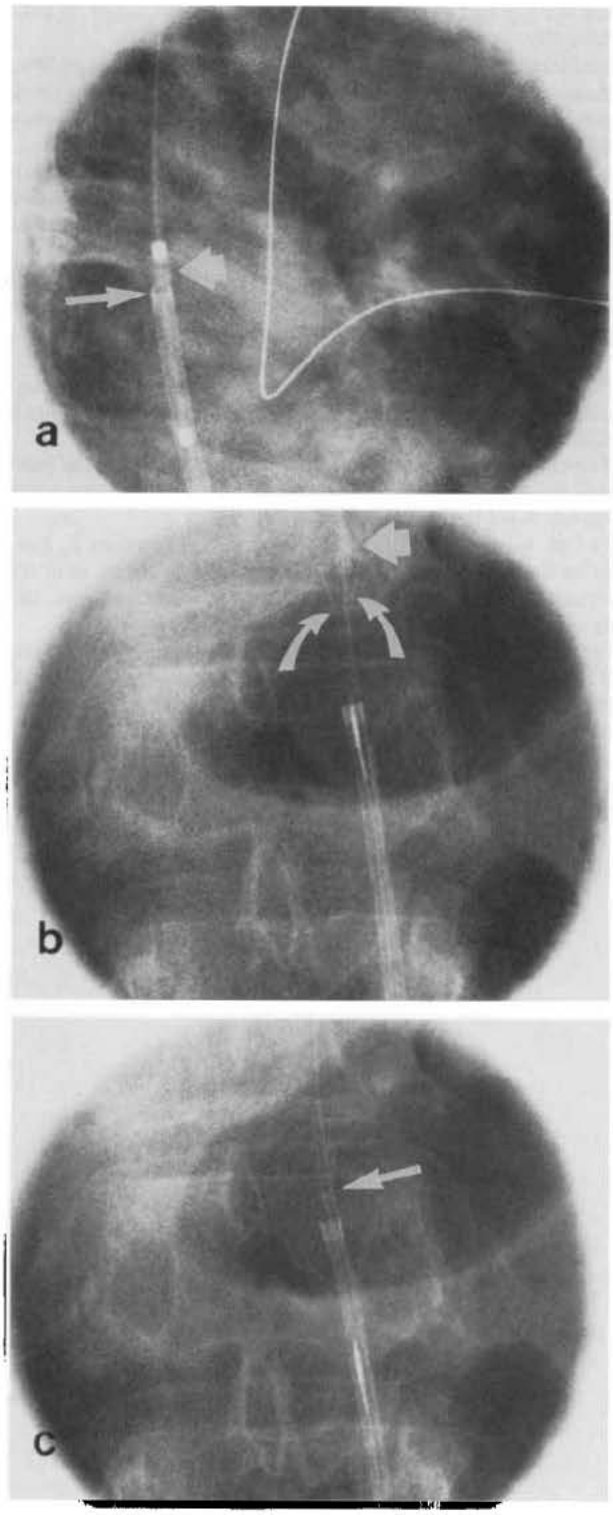

Fig. 5. (a) After attempted withdrawal of stent into the tip of the guide catheter (thin arrow), the stent is compressed and displaced toward the distal end of the deployment balloon (thick arrow). The coronary wire is still in position. (b) Open biliary forceps (curved arrows) are advanced toward the stent (thick arrow), which is now free of the deployment balloon in the distal abdominal aorta. (c) The closed biliary forceps drawing the captured stent (arrow) into the guide catheter.

two devices where the coronary wire is grasped along with the stent and withdrawn.

The third device used was the multipurpose basket. Similar stone baskets have been successful in the retrieval of intravascular and intracoronary foreign bodies [12–14]. The spiral device when open fills the vessel from wall to wall, simplifying entrapment of the stent.

The nitinol gooseneck snare has a 4 French (0.052″) catheter diameter. The other retrieval devices all have a diameter of 1.6 mm (0.064″). These devices can easily be accommodated by an 8 French guide catheter with an internal diameter of 0.080″–0.084″. Once the deployment balloon is removed, a 7 French guide catheter will also accommodate these devices, although currently all stents are delivered through 8 French or larger guide catheters.

When removing a stent with its deployment balloon (as in Case #1), all should be withdrawn to the iliac artery. The guide catheter should then be removed and the retrieval device introduced through the hemostatic sheath alongside the coronary wire. We encountered no difficulties withdrawing the captured flexible stents from the iliac arteries.

Pan et al. [15] described the use of a handmade retrieval set utilizing a 5 or 7 French catheter containing a looped coronary wire to retrieve a Palmaz-Schatz stent. Muhlestein et al. [16] commented on the use of a standard right ventricular bioptome to remove stents already deployed in canine coronary arteries (a similar scenario to our first case). By grasping its proximal end, the stent was retracted and stretched into a straight wire and withdrawn into the guide catheter. Histological study of the canine arteries demonstrated only mild endothelial denudation after the procedure. This approach has, at least in theory, the risk of stent wire transection related to use of a cutting boptome.

In summary, commercially available retrieval devices can be used to retrieve damaged flexible coronary stents. Maintaining guidewire position in the coronary tree can serve to prevent systemic embolization of a stent that has come free of its deployment balloon. The retrieval devices described facilitate practical solutions to a problem that is likely to increase in incidence; operators who plan to deploy balloon expandable coronary stents should have these devices available and be familiar with their use.

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