Nonsurgical Retrieval of Devices and Foreign Bodies

Interventional procedures for removing malfunctioned, fractured, or migrated devices.

BY KENNETH R. THOMSON, MD, FRANZCR

Interventional procedures to retrieve devices and other foreign objects from within vascular spaces are useful additions to the skill set of endovascular specialists. These objects have been previously classified as long and skinny and round and slippery.[1]

Every endovascular specialist will, at some time or another, be confronted with the problem of a device that has malfunctioned, fractured, or migrated and requires removal. Coronary artery stent migration and subsequent retrieval are the most commonly reported device misplacements because these are the devices most commonly used, but the incidence is still less than 0.5%.[2,3] Some of the devices physicians may encounter are listed in the *Classifications of Intravascular Foreign Bodies* sidebar. The reasons for migration of devices are numerous, but the most common is a misjudgment of the relative size of the device and the intended site of placement. Coronary stents are the exception because these are mostly dislodged by calcified plaque before or during placement. Different methods of retrieval are needed for each type of object. This article discusses methods for nonsurgical foreign body retrieval. In some cases, it is better not to attempt to remove the device but to render it harmless in situ.

RETRIEVAL DEVICES

There are many kinds of commercially available snares and graspers for retrieval. However, it is easy to make a loop snare with a standard 5-F angiographic catheter and a 180-cm, 0.018-inch guidewire (Figure 1). This is our most commonly used snare. Mallmann et al[4] reported 100% success using this type of device, but its usefulness was well known before this recent publication. The advantages of this type of snare are that it has a variable size loop and that it is inexpensive. If the end of the loop is kinked with forceps, this snare can be deflected to either side more predictably. The other advantage is that the angiographic catheter has a shaped tip (most commonly a Hinck or Cobra 2 shape) and, usually, better translational torque than a commercial snare.

CLASSIFICATION OF INTRAVASCULAR FOREIGN BODIES[1]

Long and Skinny	Round and Slippery
• Segment of central venous catheter	• Bullets and shotgun pellets
• Fragment of IVC filter	• Embolization coils
• Fractured guidewire	• Ureteric and bile duct calculi
• Balloon and/or tip of angioplasty catheter	• Atrial septal occluders
• Migrating stents	• Pressure balls and beads

Commercial devices include 0.038-inch single-arm forceps, snares, and graspers for inferior vena cava (IVC) filter removal, stone retrieval baskets, and loop snares designed for embolization coil retrieval. There are several cleverly designed forceps and graspers for laparoscopic use, but they are generally too short, rigid, and large in terms of caliber for endovascular use. Although the concept of grasping forceps is attractive, in most cases, it is easier to grasp the wall of the cavity or vessel rather than the foreign body itself.

In small tubes such as the bile duct or ureter, commercial stone baskets or a simple balloon catheter are effective. In the case of the bile duct, a stone just needs to be ejected into the duodenum. Ureteric stones can be delivered through a nephrostomy or per urethra. Most of the foreign bodies in the airways and upper alimentary tract are removed endoscopically without the assistance of endovascular specialists. Urethral foreign bodies usually damage the posterior urethra. This subject was reviewed by Forde et al.[5]

A loop snare can also be used for capture and change of double-pigtail ureteric stents via nephrostomy or

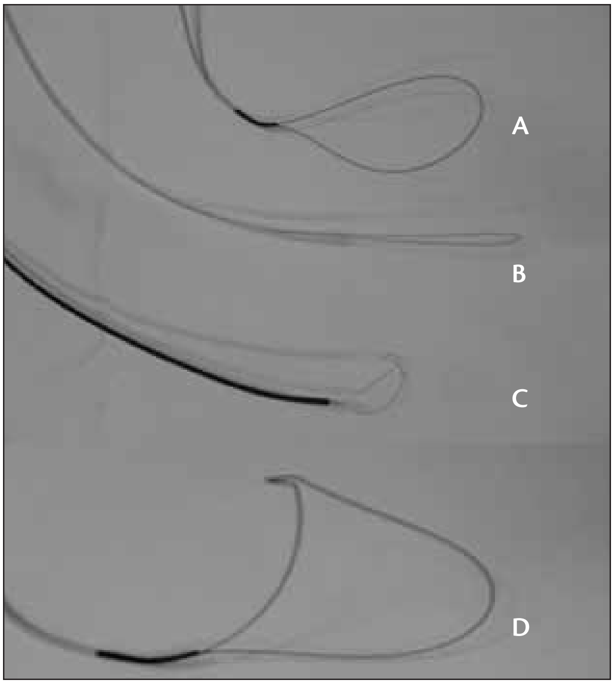

Figure 1. A selection of loop snares. From the top, a simple loop snare (A) comprising a 5-F, 0.038-inch endhole Cobra 2 catheter and a 0.018-inch, 180-cm-long guidewire. This has the advantage of being able to enlarge to fit differently sized vessels. The loop can be moved independently of the catheter tip by pushing or pulling on one of the ends of the guidewire. This loop must be preloaded before the catheter is inserted into the vessel. The second loop snare (B) is from an endoscopy set. This is designed to be positioned by the endoscope tip, and the snare is of limited size and has no intrinsic steerability. The third snare (C) is from a Cook Medical (Bloomington, IN) IVC filter retrieval set. This is designed to fit the IVC and engage a hook on the superior aspect of the IVC filter. It is difficult to use in curved vessels. The lowermost snare (D) has the same loop as the top snare, except the apex of the guidewire loop has been kinked with forceps. This makes it possible to afterload the snare once the catheter is adjacent to the foreign body. The kink allows more aggressive deflection of the snare to either side by alternately pushing or pulling one of the wire guide ends.

urethra. It is important to position the snare close to the tip of the double-pigtail stent. Once the stent tubing is externally visible, a guidewire is passed through the stent to allow replacement with a new stent, if that is required.

For larger devices within body cavities, most commonly the rectum, a four-wire snare allows better control for round and slippery objects. Most of the commercial four-wire devices are too short or rigid for intravascular use.

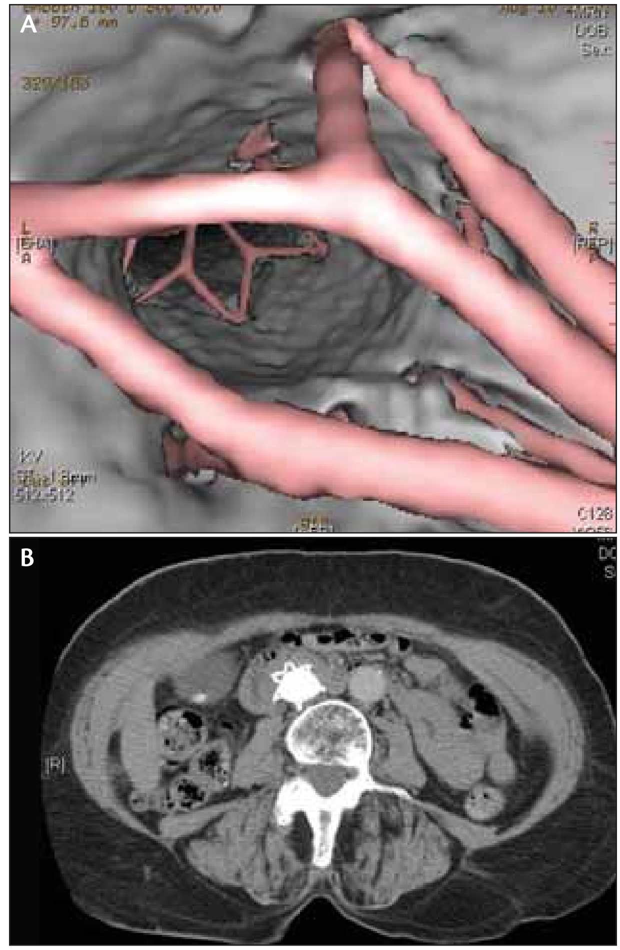

Figure 2. When an IVC filter with cross-links becomes deeply embedded in the wall of the IVC, removal of the filter requires moderate force and will result in shreds of endothelium at the site of removal. A CT endovascular reconstruction confirmed deep embedding of the central filter struts of an OptEase IVC filter (Cordis Corporation, Bridgewater, NJ) (A). An axial CT image showed that the endothelium covers a closed section of the filter limbs (B). The venogram after removal shows a ragged collection of endothelial tags that had previously covered the filter limbs (C).

METHODS

In almost every case, it is possible to remove the unwanted object without resorting to an open operation. In some cases, a large or rigid object can be captured and brought to a superficial site where simple surgical removal under local anesthetic is possible. Occasionally, intracardiac devices, such as stents and filters, may damage the tricuspid valve if they become entangled during migration[6] or retrieval, and in these cases, a surgical approach from the right atrium is preferable.

The best time to remove a device is as soon as possible after it becomes unwanted. An unwanted device becomes a foreign body and a possible source of patient complications. This axiom applies to IVC filters as well as other devices. Intravascular objects become covered by endothelium surprisingly quickly, and if the foreign body becomes incorporated with the vessel wall, it may not be possible to engage or remove it without causing significant endothelial damage.[7] In the case of large-caliber devices such as atrial septum occluders, there is a risk of aortic or large branch vessel thrombosis, and usually, open or laparoscopic surgery is required.[8]

It is not uncommon to see pieces of IVC endothelium attached to long-dwelling IVC filters after retrieval. This is most marked with filters that have closed sections in contact with the IVC endothelium (Figure 2). We have seen a retained guidewire, which was inserted in the subclavian vein during a resuscitation, that appeared in the iliac and femoral veins. The patient presented with a piece of the guidewire mandrel projecting from his calf. Endovascular retrieval failed, and at surgery, the guidewire was completely incorporated within the vein wall. It could not be retrieved without transecting the femoral vein.

Sections of silicone catheters from venous access devices may also become closely applied to the wall of the pulmonary artery and cardiac chambers. This makes it difficult or impossible to engage the tubing with a conventional snare. In this situation, provided the tubing is flexible, a catheter can be passed beneath the tubing near a less fixed portion and a snare used to complete the capture (Figure 3).

The steps in removal are deciding what to capture the foreign body with, positioning the retrieval system, engaging the foreign body, and bringing the retrieval device and foreign body to the retrieval system's point of

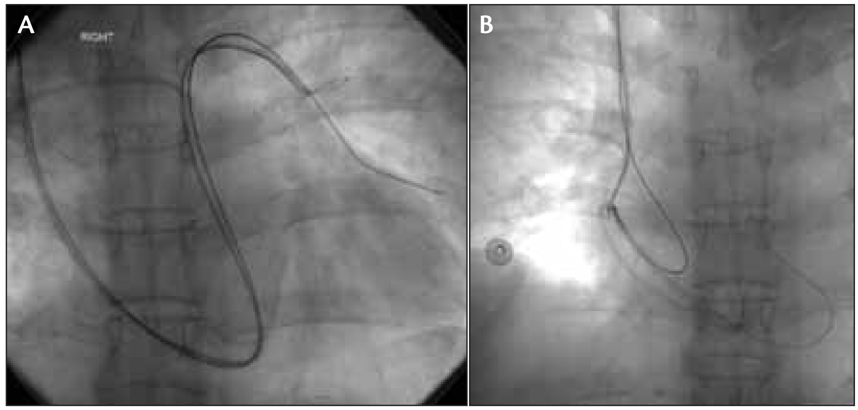

Figure 3. In this patient, a long section of Hickman catheter (Bard Peripheral Vascular, Inc., Tempe, AZ) tubing was retained when the catheter fractured during removal. As one end was embedded in a small branch pulmonary artery and the other in the right ventricle, a catheter was passed behind the Hickman tubing, replaced with a guidewire, and snared from the opposite side of the tubing. The images show the loop snare around the wire guide before removal (A); once the capture was complete, the assembly was withdrawn (B). Traction should only be applied to the snare to avoid pulling the wire guide through the loop. This technique is only possible if the foreign body is flexible and will bend. It avoids unnecessary manipulation in the right ventricle.

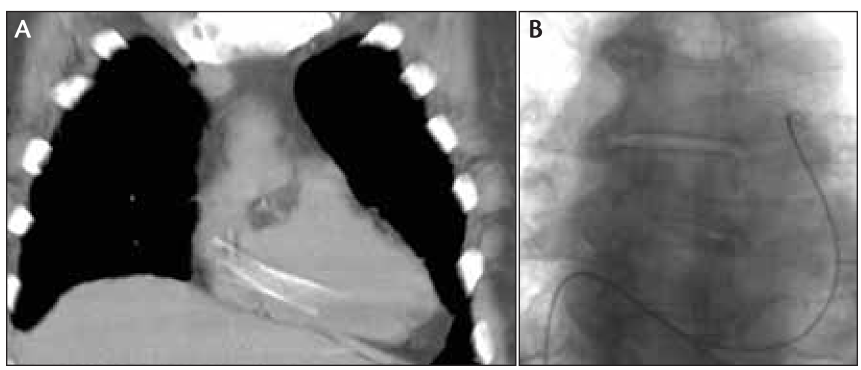

Figure 4. Intracardiac migration of a self-expanding nitinol stent. A coronal CT reconstruction shows the stent lying across the tricuspid valve (A). Cardioversion was administered by an eager cardiologist because of ventricular tachycardia caused by attempts to capture the stent in the right atrium, and the stent migrated to the pulmonary artery as a result. This made capture of the stent much easier, but if the procedure had failed, subsequent surgery would have been more complicated. Using a simple loop snare, the stent was captured near one end (B) and moved gently to the IVC. The tricuspid valve should be treated with great care to avoid damage to the valve and subsequent tricuspid incompetence.

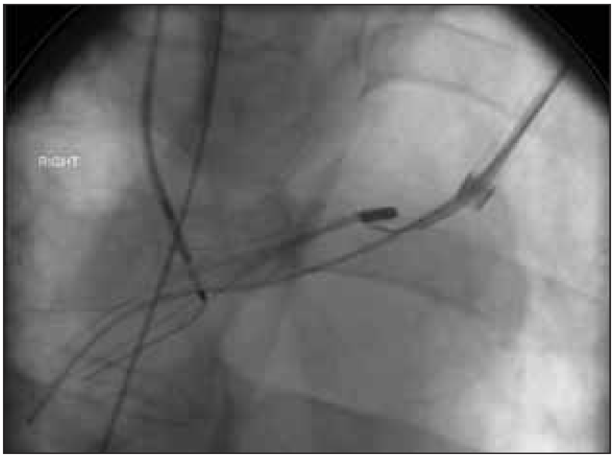

Figure 5. Migration of an ALN Optional IVC filter (ALN, Bormes les Mimosas, France) to the left brachiocephalic vein during planned retrieval. Control of this filter was lost when the grasper failed to function correctly. As a result of actions to keep the filter from entering the right ventricle, it became positioned in the left brachiocephalic vein with buckled legs. Although a large-bore catheter was inserted from the left jugular vein, retrieval through this side proved impossible. Using a pair of simple loop snares and two buddy wires, the filter was retrieved inverted to the right jugular vein where it was extracted with forceps percutaneously.

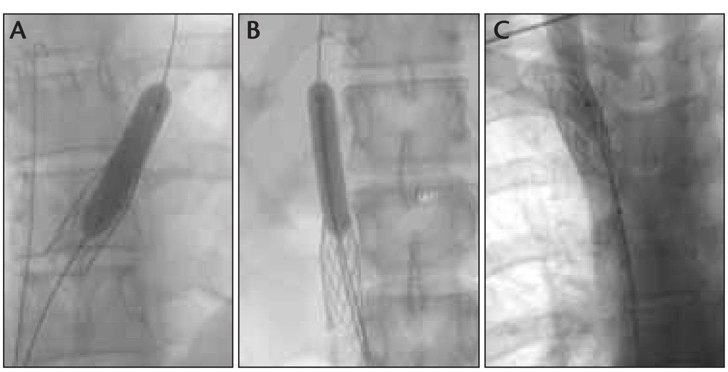

Figure 6. Migration of a Palmaz iliac stent (Cordis Corporation). This stent was intended for the left common iliac vein but migrated to the IVC as it was ballooned. To ensure the guidewire remained through the stent, the wire guide was advanced and entered the right ventricular outflow tract. A small-diameter angioplasty catheter was passed along the guidewire and through the stent, the balloon was then inflated to stop further migration (A). The initial plan was to reconfigure the proximal end of the stent to allow reinsertion in the left common iliac vein. A loop snare was passed over the inflated balloon to avoid the loop of the snare from becoming caught on the bare stent ends (B). When it became obvious that the stent could not be positioned in the common iliac vein, a decision was made to "park" the stent permanently in the right brachiocephalic vein and use a 25-mm angioplasty balloon to lock the stent in place (C). Follow-up at 1 year shows the stent is securely in place without any sequelae.

entry. It is very important to consider how the foreign body is engaged, because it may not be possible to extract a long and skinny object that will not bend easily unless it is captured near one end (Figure 4).

Consideration should be given to the delivery method of the foreign body. It may be easier to pull a stent or catheter through the tissues to the puncture site than to insert a very large access sheath. For extravascular foreign bodies, a combination of fluoroscopy and computed tomography may be helpful.[9] If "bare" delivery is planned, the access site should be enlarged so that forceps can be used to ensure that the foreign body is not lost at the access site (Figure 5).

As an alternative to removal, a misplaced stent can be repositioned where it will be innocuous. The final resting place should be where branch vessels are not compromised and the stent can be securely fixed without the risk of further migration (Figure 6).

CONCLUSION

Endovascular retrieval of foreign bodies and misplaced devices is a simple technique, and there is a large array of instruments available for this purpose. For most situations, a simple loop snare is as effective and at a far lower cost than commercial snares. In most cases, open or even laparoscopic surgery can be avoided. It is important to remember that although no job is too small, some jobs are too hard. In the latter case, the interventionist can always either leave it alone or resort to open surgery. ■

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