Advanced Techniques for Complicated IVC Filter Retrievals: A Clinical Perspective

Kush Shah MD, MBA[1]; Michael O'Neill, MD[2]; Ami Vakharia, MD[2];
Reginald Baker, MD[2]; Jason Salsamendi, MD[2]; Govindarajan Narayanan, MD[2]
From the [1]University of Miami School of Medicine and [2]Jackson Memorial Hospital Department of Radiology, Miami, Florida.

ABSTRACT: The development of retrievable inferior vena cava (IVC) filters and the expansion of accepted placement indications have resulted in a significant rise in the number of IVC filter placements. However, retrieval rates remain low, increasing the likelihood of longer dwell times and complicated retrievals. Interest in advanced IVC filter retrieval techniques has grown, but standardized approaches or nomenclature for these procedures do not exist. Therefore, we describe our own institutional experiences with these procedures with case examples.

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Inferior vena cava (IVC) filter placement is common and has increased dramatically in recent years. From 1999 to 2008, there was an increase in placement of IVC filters by 111.5%.[1] The development of retrievable IVC filters has caused significant increases in utilization due to associated expansion of the accepted indications for placement. Since 2009, the percentage of retrievable IVC filters placed has consistently exceeded that of permanent filters.

Meanwhile, there is an increased awareness of the potential complications associated with IVC filters, particularly when filter dwell times exceed those clinically required. These complications are well known and include caval thrombosis or narrowing, IVC or adjacent vessel/organ perforation, extension of lower extremity deep vein thrombosis, filter fracture, filter migration, embolization, and more.[2] Generally, a filter is removed when the patient is no longer thought to be at risk for future thromboembolic disease, or when the patient is deemed to be in an "anticoagulable" state.

Filter retrieval rates remain low, ranging from 20% to 60%.[2] A 2011 study found that in 2008, 65,041 filters were placed in the Medicare population, but only 1.2-5.1% were removed.[3] With these low retrieval rates, the likelihood of longer dwell times and probably the number of complicated retrievals increases.[2] A recent study measured safety and efficacy of IVC filter retrieval with different dwell times, ranging from 1 to 175 days, with a mean of 67.1, with 100% technical success and 88% clinical success. [4] Another study has even been shown to successfully retrieve a filter as late as 3,006 days after implantation.[2] As a result, in many practices including ours, a general policy of a 3- to 6-month dwell time is usually applied, in order to offset the potential increased risk of complications owing to longer dwell times as have been shown in prior studies.[5,6] Yet, one should bear in mind that complicated retrievals may potentially be seen with any dwell time. Furthermore, longer dwell times should not generally preclude endovascular retrieval attempts, as other studies have shown successful retrievals with dwell times extending to hundreds of days.[6,7] Routine and complex IVC filter retrieval is further complicated by the plethora of IVC filter designs currently available and new designs and ongoing modifications of old ones. Each new filter design or iteration, combined with case-specific variables can result in unique case-by-case challenges. As such, there can be significant variations in retrieval times and techniques utilized. It is for all of these reasons, both technical and clinical, that the assessment and standardized approach to complex IVC filter retrieval remains challenging.

METHODS

Selected representative cases of complicated IVC filter retrievals performed at our institution between 2010 and 2013 were retrospectively reviewed, analyzed, and then described in detail. A pertinent literature review was performed regarding complex IVC filter retrievals.

RESULTS

In most institutions, including ours, most IVC filter retrieval procedures are straightforward and can be performed without complications or the need for advanced techniques. In such ideal cases where no complicated factors exist (i.e. filter migration, fracture, angulation, adjacent visceral penetration, or caval adherence), IVC filter retrieval is routinely achieved via a transjugular approach using a standard retrieval snare or recovery cone. In our experience, retrieval remains safe and feasible with a clot burden up to approximately 25%.

Currently, routine preprocedure imaging has not been recommended or mandated to evaluate for high-risk patients except when patients have not been placed on an anticoagulant for suspected venous thromboembolism (VTE). According to the Society for Interventional Radiology guidelines 2010, Doppler ultrasound of the lower extremity veins is indicated in these patients.[1]

At our institution, prior to any filter retrieval, we first obtain a scout film followed by a venogram in order to assess the filter and to rule out any obvious complicating feature, such as any abnormal positioning, tilt, or migration of the filter. Further, the venogram is performed prior to removal in order to assess for the presence of clot within the filter. According to the Society of Interventional Radiology (SIR) guidelines 2010, if there is a large clot burden the filter should not be removed.[1] However, if minimal thrombus is present in the filter, it can be retrieved. Minimal or insignificant clot burden has been defined as less than 25%.[8] Other features, such as adherence to the IVC, tines outside the IVC, or penetration of adjacent structures should be assessed prior to retrieval if a preprocedure computed tomography (CT) scan is available.[9] Ideally, the filter should be positioned centrally within the IVC, with the filter hook oriented along the longitudinal axis of the IVC and easily accessible. Although the presence of these risk factors does not by any means rule out use of the standard approach, it is important to account for any increased risk associated with these complications. In most uncomplicated cases, we find that the standard approach may be used with a snare or cone retrieval device.

STANDARD REMOVAL

For a basic retrieval, a guidewire is aligned with the hook of the IVC filter and a vascular sheath is advanced over the wire and positioned over the filter apex. Then a retrieval snare, such as those described below, is advanced over the wire and through the sheath, to engage the filter hook. The filter is retrieved via the vascular sheath, usually without any complication.

Gooseneck Snare

In certain cases, orientation of the apex of the filter can create a particularly difficult challenge with a standard snare or cone approach. The tilt of the IVC can be in the anteroposterior (AP) or transverse direction. With its 90-degree angle, the Amplatz Goose Neck Snare (ev3) can prove useful. In our experience, utilization of this snare has often proved more useful for transversely angulated filters than other retrieval devices.

EN Snare

Another option is the EN Snare device (Merit Medical), featuring 3 snare loops, theoretically increasing the likelihood that the hook can be engaged. In our experience, it is particularly useful if tilt of the filter is in the AP orientation, where we have seen that the gooseneck snare may not be quite as effective.

Recovery Cone

If the filter apex and/or hook are less accessible due to filter angulation or partially embedded filter, a recovery cone rather than a snare can also be used to retrieve the filter. Much of the procedure is the same, but the final steps differ from when utilizing a snare. Because the cone spans a relatively large area, the probability of grasping the hook increases, thereby facilitating retrieval. It should be remembered some sheaths, such as the one we use (Recovery Cone; Bard Peripheral Vascular) do not have a hemostatic valve and also may be longer, requiring exchange-length guidewires.

STIFF-WIRE DISPLACEMENT

The tilt of the filter may be such that the hook and/or apex will be in contact with the caval wall, or even embedded or epithelialized. This in itself may result in multiple retrieval failures. In such cases, one option to consider is the stiff-wire displacement technique. In particular, this technique is utilized when presented with conical filters, such as Celect filters (Cook Medical). A stiff wire, such as the Amplatz Super Stiff Guidewire (Boston Scientific) would then be passed alongside the filter, between it and the caval wall, which may help reorient the filter apex. Once separation has been achieved, the orientation of the hook toward the lumen may then facilitate engagement with a snare device. At this point, the catheter and sheath can be advanced to the top of the filter, which is then engaged as discussed above. Alternatively, the snare may also be deployed alongside the filter after wire placement in order to further aid in filter separation from the caval wall.

Theoretically, there is a small risk of filter fracture, derangement, or migration associated with using a stiff wire to separate an embedded filter hook, which may further complicate retrieval. However, we have not encountered any such case in our practice.

BALLOON DISPLACEMENT

If the above methods are unsuccessful, another option for embedded IVC filters is the balloon displacement technique. The risk of filter migration, derangement, or fracture is probably more than the stiff wire technique, and we seldom employ this method unless others have failed. However, among advanced techniques, we find that it is somewhat less technically demanding than some of the others below.

Between the caval wall and the filter, a stiff wire followed by an angioplasty balloon is passed through the sheath to the site of the filter hook, and is then inflated. The inflated balloon can create radial forces on the superior aspects of the struts or apex to loosen and dissect embedded filter elements from the caval wall, enabling subsequent retrieval as above.

"SANDWICH" TECHNIQUE

In certain instances, single access methods may not be adequate. One example is when the filter tines are adherent to the caval wall, which requires a technique to engage both the filter legs and apex to avoid filter fracture or embolization. In these scenarios, we use a second access, usually femoral vein. With snares and guide wires at both ends, traction from each direction can safely free an embedded filter and allow for subsequent retrieval from either access point. We refer to this as the "sandwich" technique because of the dual sheaths from two access points used to place traction on the filter and align it. The first access is the standard transjugular approach, often with a snare or retrieval cone passed through a straight catheter to the hook. Encountering difficulty with retrieval, a secondary access is then obtained via the femoral vein. A sheath is passed from the femoral access point to the bottom of the filter, and a snare is introduced. The snare is then used to engage as many of the filter tines as possible in order to stabilize the filter. The sheath is then advanced over the captured filter tines from the jugular access. We find this method also facilitates adjustments to be made from the first access point, including repositioning, redeployment, change of snares/sheaths, etc., in order to prevent migration or other complications of the filter.

"TELESCOPIC SHEATH" TECHNIQUE

At our institution, we developed another dual-access option to prevent inopportune redeployment of partially sheathed IVC filters. We refer to it as the "telescopic sheath" technique. In rare cases, snared IVC filters are not completely retrieved into the sheath despite application of hazardous forces. This technique provides an excellent safety method by ensheathing the whole filter, thus preventing inopportune redeployment as the filter is being removed. However, experienced consultation is needed. Similar to the "sandwich" technique, this begins with single transjugular access, followed by femoral access upon encountering difficulty. At this point, the accessible filter tines are again engaged from below. Using the 10 Fr to 12 Fr sheath from above, in combination with a larger 14 Fr to 16 Fr sheath from below, the jugular sheath is "telescoped" into the femoral sheath, entrapping the filter within. Subsequently, the IVC filter is completely removed from the femoral sheath.

"SLING" TECHNIQUE

An especially useful technique for an embedded filter hook, particularly when dealing with less conical shaped filters such as the Bard filters, is the sling technique. This method utilizes a reverse-curve catheter with a short radius, which is advanced over the guidewire and distal to the filter. As the guidewire advances through this catheter, it makes a U-turn. Next, a snare is passed in a paraxial fashion through the same sheath (a sufficiently sized sheath such as 16 Fr should be used) and snares the end of the reversed guidewire just proximal to the filter, similar to a technique previously described.[2] The result is a U-shaped "sling" in the wire that usually surrounds the medial or lateral aspect of the filter, preferably near its apex. Gentle traction is then applied to both ends of the guidewire, which tightens the sling around the targeted portion of the filter. Simultaneous traction applied to both the catheter and snared guidewire may then displace the hook from the wall and ensheath the filter, which is then removed. This technique can be further augmented by advancing a metal cannula over both ends of an exchange-length 0.035″ regular angled Glidewire (Terumo). The cannula is then advanced to the IVC filter tine and crimps the wire to the filter, not allowing for the Glidewire to slip from the IVC filter.

One should be mindful of the possibility of filter derangement with this technique, which can further complicate retrieval. Therefore we use this technique as a bail-out option.

Two other techniques certainly worth mentioning are the forceps technique and laser-assisted technique. Both of these involve the use of more aggressive measures to disengage the filter hook or struts from tissue that has incorporated around it. In a study by Stavropoulos et al, rigid endobronchial forceps were used to successfully remove 20 embedded IVC filters in 21 patients when the filter was tilted and the hook embedded in the wall of the IVC.[10] Further, in a study by Kuo et al, photothermal tissue ablation was attempted with a laser sheath powered by a 308-nm xenon chloride excimer laser. Laser-assisted retrieval was successful in 98.0% of the cases with mean implantation of 855 days.[11]

Although permanent filters are not designed to be removed, there have been reports of successful removal. One such example was reported by Kuo et al who describe a case of a Vena Tech LGM filter (B Braun) that was successfully removed after 16 years.[12] This was done in a piecemeal fashion using the PRIME technique (Piecemeal Removal by Intentional Mechanical fracture).[12] Rigid forceps were used to cause mechanical fracture of the filter in areas of reduced cross-sectional load bearing. As a result, all obstructing filter elements were successfully removed. As will be discussed further below, the risks of complications like migration of filter fragments must be weighed against the potential benefit.

DISCUSSION

The benefits of filter retrieval generally far outweigh the risks, especially when the patient is deemed to be in an "anticoagulable" state or no longer at risk for future thromboembolic disease. Earlier retrieval will likely prevent many associated complications of indwelling IVC filters. However, as dwell times increase further beyond those clinically indicated, retrieval can become increasingly challenging, for the reasons discussed above.

As a part of the appropriate management of patients who receive IVC filters, vigilant follow-up is warranted. When there is a structured follow-up clinic in place, studies have shown retrieval rates of 50% to 60% can be achieved when compared to the historical rate of 20%.[13] This underscores how responsible care extends beyond appropriate selection and technically sound placement. It requires that physicians who place these filters take ownership of the responsibility needed to ensure timely retrieval.

The multiple patient- and filter-specific variables involved have likely delayed a widely accepted standardized approach to complicated IVC filter retrieval, which is an important goal for future practice. While by no means an exhaustive list, numerous excellent reviews featuring named individual techniques and their variations have been written.[2,5-8,14-19] It should be kept in mind that some feature similar techniques under different names, while others are unique in both technique and nomenclature. Therefore, the content herein simply comprises our institutional perspective in hopes to guide future practice and troubleshoot potential complications. There are risks and potential complications involved with advanced retrieval technique including IVC dissection, IVC intussusception, IVC thrombus/stenosis, filter fracture with embedded strut, IVC injury with hemorrhage, and vascular injury from complicated venous access.[18] Despite the higher complication rates associated with advanced compared to standard techniques (5.3% vs 0.4%; $P<.05$),[19] advanced retrieval may be preferable to the risks associated with leaving a filter in place permanently.

CONCLUSION

The high incidence and prevalence of IVC filter placement and the advent of newer models and retrieval devices will continue to fuel the innovation of advanced retrieval techniques. As techniques for complicated retrievals continue to develop and evolve, the universal development of programs to better monitor patients with these devices, in addition to the establishment of standardized criteria and nomenclature related to complex filter retrieval, will likely aid our future practice as we encounter increasingly challenging IVC filter retrievals.

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Address for correspondence: Kush Shah, MD, MBA, University of Miami School of Medicine, 1611 NW 12th Avenue, Miami, Florida 33026, United States. Email: kush.shah@med.miami.edu.

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