Inferior Vena Cava Filter Retrieval

Tips on the best methods for retrieving an IVC filter.

BY THUONG G. VAN HA, MD

Studies have shown that inferior vena cava (IVC) filters are effective in the prevention or reduction of pulmonary embolism (PE) in patients with contraindications to anticoagulation or in whom anticoagulation has failed.[1-3] There are risks associated with increased indwelling time with these devices, including fracture, IVC penetration, IVC thrombosis, and development or worsening of deep venous thrombosis (DVT).[4-7] Retrievable filters were developed to avoid long-term complications in patients who need only short-term caval filtration. During the last several years, the use of retrievable filters has been on the rise, with low complications and good efficacy in the prevention of PE.[8-13]

However, their slightly higher cost and relative lack of long-term follow-up compared to the available permanent devices may limit their general use. Table 1 details several filters that are currently available.

Early data suggest that a significant portion of retrievable filters are not removed, and many patients do not receive long-term follow-up for these devices. Two types of retrieval rates are reported: (1) the overall retrieval rate refers to the rate of retrieval of all filters placed with intention to retrieve, and (2) the procedural retrieval rate refers to the technical success of filters undergoing removal attempts. Numerous studies have shown the overall retrieval rate to be low for various reasons, including lack of patient follow-up, continued need for caval filtration, and the inability to remove filters.[14-16] The reported procedural retrieval success rate (successful removal rate) tends to be high.[11-14]

TABLE 1. RETRIEVABLE FILTERS

Type	Comments	Retrieval Set Size
ALN (ALN, Bormes les Mimosas, France)	Stainless steel	9 F
Celect (Cook Medical, Bloomington, IN)	Second-generation GTF	11 F
Günther Tulip filter (GTF) (Cook Medical)	Longest history	11 F
G2 and G2 X (Bard Peripheral Vascular, Inc., Tempe, AZ)	Nitinol design	12 F
Optease (Cordis Corporation, Warren, NJ)	Directional polarity	7- to 10-F sheath
Option (Angiotech Pharmaceuticals, Inc., Vancouver, British Columbia, Canada)	Nitinol design	8 or 10 F

PLACEMENT

Avoid Tilt

Ease of retrievability is significantly influenced by filter placement. The avoidance of significant tilt and wall contact with the apex or hook of the filter will make the filter less likely to be significantly incorporated into the caval wall. Additionally, larger IVC diameters can result in increased tilt. A large tilt angle may decrease the effectiveness of the filter in trapping clots, and it also increases technical difficulty during removal. A tilted filter has increased exposure to the caval wall, which can lead to significant incorporation. Filters with significant tilt should be repositioned immediately. Certain filters are more "self-centering" because of their design, although they can still tilt at placement.

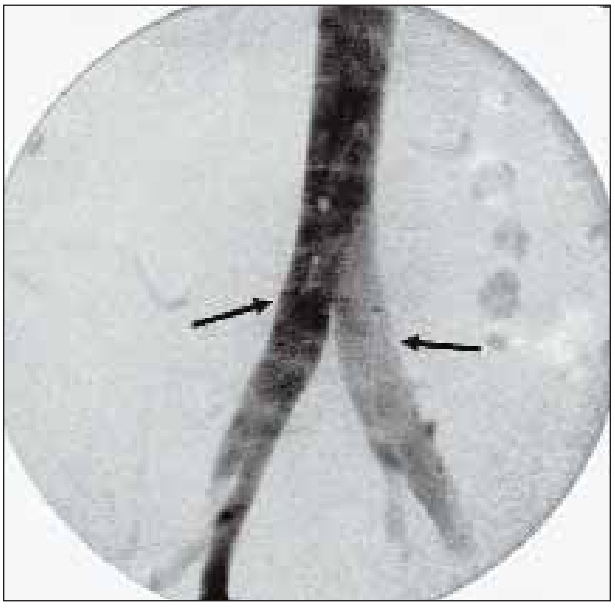

Figure 1. A 45-year-old bariatric patient had filter placement before surgery. IVC venography was performed after filter placement. Patient had megacava (IVC diameter > 3 cm). Filters were placed in the iliac veins (arrows).

IVC Size Consideration

Furthermore, do not place a filter in an IVC that is too large for the device. For the G2 and G2 X filters, the IVC diameter should be 28 mm or less. For the Option filter, the IVC diameter should be 30 mm or less. For the GTF or Celect filter, the recommended diameter of the IVC is 30 mm or less. When an IVC diameter is too large, it can result in tilting, migration, fracture, or penetration, making retrieval difficult or impossible. For this reason, it is important to properly size the IVC diameter using the IVC venogram before filter placement. For a megacava, considerations should be given to bilateral iliac vein location for placement (Figure 1).

RETRIEVAL

Preretrieval Workup

The retrieval indication must be reviewed for appropriateness. Do not remove filters without assessing the indication for retrieval beforehand. Some patients need to be anticoagulated, and these arrangements must be made. The type of anticoagulation (either low-molecular-weight heparin or warfarin) should be determined before the procedure. Lower extremity duplex ultrasound is performed in patients without a history of DVT and who have had a filter placed for prophylaxis. In patients who have a history of DVT and will resume anticoagulation after filter retrieval, ultrasound is usually not necessary unless there is a change in clinical condition that warrants it.

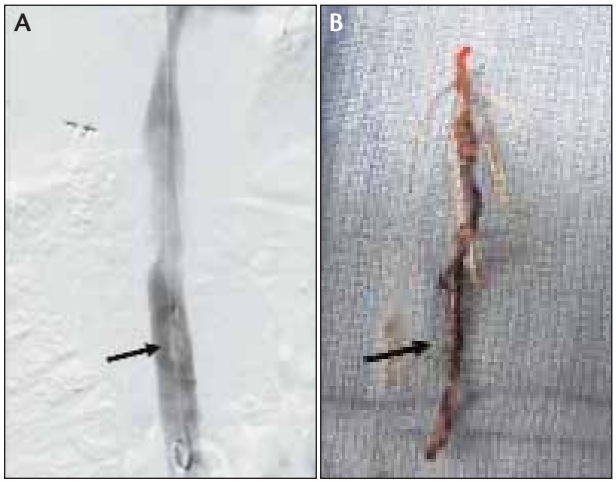

Figure 2. Venogram obtained of a patient before filter retrieval showed clot within the filter cone (arrow) (A). After filter extraction, a photograph was obtained showing the clot, which elongated as it was pulled into the sheath (arrow) (B).

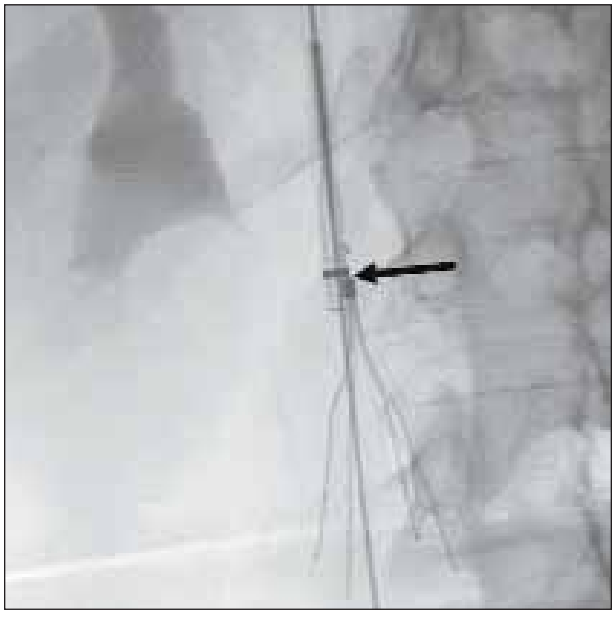

Figure 3. Image obtained during GTF retrieval showed the hook of the filter outside the sheath on this view (arrow), preventing sheathing of the filter.

Clot Burden

In cases of small clots within the filter cone (25% or less cone volume), retrieval may be performed (Figure 2). However, when there is large clot burden, filters are usually not removed, and patients are typically anticoagulated and brought back at a later time for reassessment.

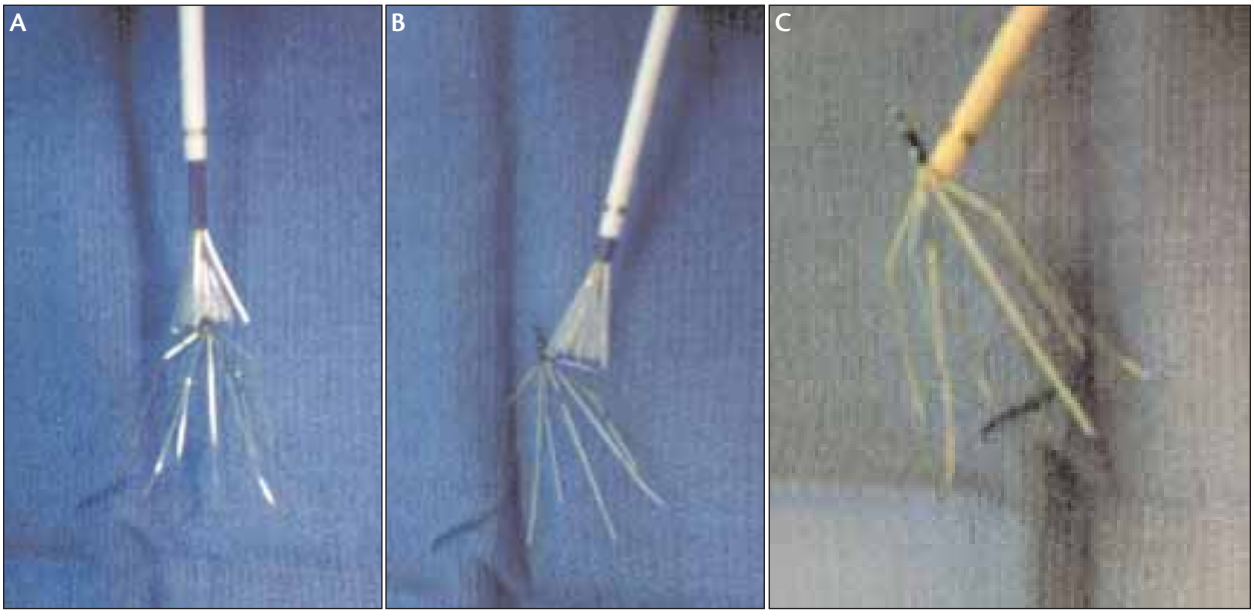

Figure 4. Example of T-bone of the G2 filter. On this view, it could appear that the cone is directly over the filter tip (A). On this perpendicular view, however, the cone is clearly to the side of the filter (B). The filter could be grasped on the side by the cone, forming the T-bone configuration and not allowing the filter to be properly sheathed (C).

Figure 5. This filter was significantly tilted at placement. The filter was recaptured and repositioned properly (not shown).

Avoid "T-Bone"

The "T-bone" formation between the filter tip and retrieval sheath should be avoided. When apparent engagement of the filter tip or hook is associated with difficulty of sheathing the filter, oblique views are needed to ensure that the tip of the filter is within the sheath. The most likely scenario is that the filter tip is outside the sheath, which can be demonstrated on oblique views. For GTF or Celect, snaring the filter below the hook, rather than at the hook itself, can result in a slight tilt angle, and the filter tip forms a T-bone configuration in relation to the sheath (Figure 3).

Allowing the cone to grasp the side of filter in the case of the G2 or G2 X will result in the T-boning and inability to sheathe the filter (Figure 4). When the angle of the filter in relation to the retrieval cone is not straight, the cone can dock on the side of the filter; the side of the filter rather than the tip is grasped. This will prevent sheathing of the filter. From one view, it may look like the tip is within the sheath, but different views will prove otherwise. When this occurs, it is important to release the filter and re-engage it correctly. Application of too much force in these cases can deform the filter and the sheath.

Tilted Filter

A significantly tilted filter with or without an incorporated filter tip can prevent engagement with a snare or cone (Figure 5). Various reports have described ways of dealing with tilted filter retrieval with or without tip (or hook) incorporation. The loop snare technique has been previously described.[17] Caution should be taken when this technique is used with the Celect or G2 filters, because the arms and legs of the filter around which the loop is formed could be severely snagged. Furthermore, this could prevent further retrieval attempts. For the GTF, it is important not to loop the wire around the secondary struts, because this will pull

Figure 6. The loop snare technique was used in this GTF retrieval. The secondary struts were engaged resulting in a bungled mesh at the top of the filter (arrow), preventing its retrieval. Avoiding the secondary struts of the GTF is important for proper retrieval.

up the struts and prevent proper sheathing of the filter (Figure 6).

Excessive Force

It is unknown how much force can be applied in filter retrieval before vascular damage will result. The degree of incorporation determines the amount of force required to pull the filter off the IVC wall. In general, due to its design, the GTF tends to become incorporated more from the wall contact of the secondary legs, whereas the Celect and G2 do not have the same degree of incorporation and, at least in theory, are less likely to be so incorporated to the extent that it makes retrieval impossible. When excessive force is used, damage to the IVC may result (Figure 7).

DISCUSSION

PE has been reported as one of the most preventable causes of death in hospitalized patients, in addition to being a significant source of morbidity.[18,19] Anticoagulation is the standard therapy for DVT even though a high incidence of PE occurs despite adequate anticoagulation.[18] The safety and efficacy of permanent

Figure 7. Venogram obtained after IVC retrieval, which required more than usual force, showing contrast extravasation (arrow) (A). The patient was stable and asymptomatic. Follow-up venogram after 10 minutes of observation showed the defect to be resolved (arrow) (B).

> "The use of retrievable filters has been increasing both as permanent devices and short-term protection."

IVC filters has been demonstrated in numerous studies,[1-3,7] but their use has been continuously questioned.[20,21] A randomized prospective study showed a lower rate of PE in patients who had an IVC filter implanted compared to the group who did not at 12 days, but there was no difference in the PE or survival rate at 2 years, suggesting there is short-term benefit with filters.[22] There might be an advantage to using the retrievable filters to prevent short-term PE, which also avoids long-term complications. The use of retrievable filters has been increasing both as permanent devices and short-term protection. Even though long-term data are lacking, studies have shown these new filters to be safe and effective,[8-12] and there is a continuous effort to improve their design.

The SIR guidelines specify that indications for an IVC filter can be divided into three categories: absolute, relative, and prophylactic.[23] Absolute indications are documented venous thromboembolic disease with contraindication to anticoagulation, failure of anticoagulation, significant complications from anticoagulation, or the inability to be properly anticoagulated. Relative indications include large free-floating thrombus, thromboembolic disease with limited cardiopulmonary

reserve, recurrent PE in a patient with an IVC filter in place, and DVT thrombolysis. In addition, IVC filter placement has been advocated prophylactically in patients with high risk of venous thromboembolic disease. This group of patients includes those with massive trauma and those with an upcoming surgery who have prolonged immobility. This group of patients would most benefit from temporary IVC filtration from retrievable filters.[24-26]

CONCLUSION

There have been numerous reports of different techniques that have been used in difficult filter retrievals.[17,27-30] In all interventional procedures, care must be taken to avoid complications. It is important to remember that future retrievability is most influenced by initial filter placement. In cases when it is not possible to retrieve the filter, it becomes a permanent device. As such, it is vital not to alter its configuration, because it may make it less effective and more prone to complications. ■

Thuong G. Van Ha, MD, is with the Department of Radiology at the University of Chicago Medical Center in Chicago, Illinois. He has disclosed that he receives speaker honoraria from Cook Medical. Dr. Van Ha may be reached at (773) 702-1607; tgvanha@uchicago.edu.

1. Ferris EJ, McCowan TC, Carver DK, et al. Percutaneous inferior vena caval filters: follow-up of seven designs in 320 patients. Radiology. 1993;188:851-856.
2. Greenfield LJ, Proctor MC. Twenty-year clinical experience with the Greenfield filter. Cardiovasc Surg. 1995;3:199-205.
3. Athanasoulis CA, Kaufman JA, Halpern EF, et al. Inferior vena caval filters: review of a 26-year single-center experience. Radiology. 2000;216:54-66.
4. Kantor A, Glanz S, Gordon DH, et al. Percutaneous insertion of the Kimray-Greenfield filter: incidence of femoral vein thrombosis. AJR Am J Roentgenol. 1987;149:1065-1066.
5. Grassi CJ, Matsumoto AH, Teitelbaum GP. Vena caval occlusion after Simon nitinol filter placement: identification with MR imaging in patients with malignancy. J Vasc Intervent Radiol. 1992;3:535-539.
6. Blebea J, Wilson R, Waybill P, et al. Deep venous thrombosis after percutaneous insertion of vena caval filters. J Vasc Surg. 1999;30:821-828.
7. Crochet DP, Stora O, Ferry D, et al. Vena Tech-LGM filter: long-term results of a prospective study. Radiology. 1993;188:857-860.
8. Millward SF, Bhargava A, Aquino J Jr, et al. Gunther Tulip filter: preliminary clinical experience with retrieval. J Vasc Intervent Radiol. 2000;11:75-82.
9. Millward SF, Oliva VL, Bell SD, et al. Gunther Tulip retrievable vena cava filter: results from the registry of the Canadian Interventional Radiology Association. J Vasc Intervent Radiol. 2001;12:1053-1058.
10. Kinney TB. Update on inferior vena cava filters. J Vasc Intervent Radiol. 2003;14:425-440.
11. Grande WJ, Trerotola SO, Reilly PM, et al. Experience with the recovery filter as a retrievable inferior vena cava filter. J Vasc Intervent Radiol. 2005;16:189-1193.
12. Ray CE Jr, Mitchell E, Zipser S, et al. Outcomes with retrievable inferior vena cava filters: a multicenter study. J Vasc Intervent Radiol. 2006;17:1595-1604.
13. Van Ha TG, Chien AS, Funaki BS, et al. Use of retrievable compared to permanent inferior vena cava filters: a single-institution experience. Cardiovasc Intervent Radiol. 2008;31:308-315.
14. De Gregorio MA, Gamboa P, Bonilla DL, et al. Retrieval of GЯnther Tulip optional vena cava filters 30 days after implantation: a prospective clinical study. J Vasc Intervent Radiol. 2006;17(11 pt 1):1781-1789.
15. Karmy-Jones R, Jurkovich GJ, Velmahos GC, et al. Practice patterns and outcomes of retrievable vena cava filters in trauma patients: an AAST multicenter study. J Trauma. 2007;62:17-24.
16. Johnson ON, Gillespie DL, Aidinian G, et al. The use of retrievable inferior vena cava filters in severely injured military trauma patients. J Vasc Surg. 2009;49:410-416.
17. Van Ha TG, Vinokur O, Lorenz J, et al. Techniques used for difficult retrievals of the Gunther Tulip inferior vena cava filter: experience in 32 patients. J Vasc Intervent Radiol. 2009;20:92-99.
18. Bick RL. Hereditary and acquired thrombophilia. Part I. Preface. Semin Thromb Hemost. 1999;25:251-253.
19. Goldhaber SZ. Pulmonary embolism. N Engl J Med. 1998;339:93-104.
20. Arnold TE, Karabinis VD, Mehta V, et al. Potential overuse of the inferior vena cava filter. Surg Gynecol Obstet. 1993;177:463-467.
21. Haire WD. Vena caval filters for the prevention of pulmonary embolism. N Engl J Med. 1998;338:463-464.
22. Decousus H, Leizorovicz A, Parent F, et al. A clinical trial of vena caval filters in the prevention of pulmonary embolism in patients with proximal deep vein thrombosis. N Engl J Med. 1998;338:409-415.
23. Kaufman JA, Kinney TB, Streiff MB, et al. Guidelines for the use of retrievable and convertible vena cava filters: report from the Society of Interventional Radiology multidisciplinary consensus conference. J Vasc Intervent Radiol. 2006;17:449-459.
24. Wojcik R, Cipolle MD, Fearen I, et al. Long-term follow-up of trauma patients with a vena caval filter. J Trauma. 2000;49:839-843.
25. Streiff MB. Vena caval filters: a comprehensive review. Blood. 2000;95:36693677.
26. Piano G, Ketteler ER, Prachand V, et al. Safety, feasibility, and outcome of retrievable vena cava filters in high-risk surgical patients. J Vasc Surg. 2007;45:784-788.
27. Kuo WT, Bostaph AS, Loh CT, et al. Retrieval of trapped GЯnther Tulip inferior vena cava filters: snare-over-guide wire loop technique. J Vasc Intervent Radiol. 2006;17:1845-1849.
28. Burke CT, Dixon RG, Stavas JM. Use of rigid bronchoscopic forceps in the difficult retrieval of the GЯnther Tulip inferior vena cava filter. J. Vasc Interv Radiol 2007. 18: 1319-1323.
29. Turba UC, Glaiberman C, Picus D, et al. Management of severe vena cava filter tilting: experience with Bard G-2 filters. J Vasc Intervent Radiol. 2008;19:449-453.
30. Van Ha TG, Keblinskas D, Funaki B, et al. Removal of Gunther Tulip vena cava filter through femoral vein approach. J Vasc Intervent Radiol. 2005;16:391-394.