Venous thromboembolism (VTE) is common, with an incidence of >400 out of 100,000 people in the United States. VTE recurrence is also frequent, occurring in 40% of patients, with mortality as high as 30%. Also, if left untreated, pulmonary embolism (PE) will occur in as many as 40% of all proximal deep vein thrombosis (DVT). Although first-line treatment for VTE is anticoagulation, some patients cannot receive this therapy, and others will experience treatment failure. Consequently, inferior vena cava filter (IVCF) use has been steadily rising in the United States and Europe for the past 2 decades.

Most IVCFs in modern use allow for retrieval once the indication for use has passed. Practically, a variety of devices and techniques with escalating aggressiveness can be used to remove filters, and the Food and Drug Administration recommends that efforts should be made to retrieve these devices as early as possible. When filters are centered in the inferior vena cava and not firmly attached to the caval walls, dedicated filter grasping devices are often all that is required. A problem arises when filter components are embedded into the caval wall. In these cases, more aggressive retrieval techniques need to be used. Existing techniques may include use of endobronchial forceps and, in extreme cases, open surgical removal. Another solution that may be appropriate in cases of caval thrombosis or occlusion is to perform venoplasty and stenting. In these cases, the IVCF may be retrieved or restrained between a stent and the caval wall.

In this issue of Circulation: Cardiovascular Interventions, Kuo et al tackle this problem by using a novel technique. They present their prospective experience in 100 consecutive patients in whom laser-assisted removal of embedded IVCF was implemented. Filters were retained for a mean of 855 days, some having been implanted for >18 years, whereas others required special efforts after only 37 days. By using a combination of a laser sheath (Spectranetics, Colorado Springs, CO) and a force gauge to ensure that the force being used did not exceed safe limits, retrieval rate was 98%, although not all filters were designed for retrieval. Major adverse events occurred in 3% of cases. During postprocedure surveillance, 4 other patients experienced adverse events, not necessarily directly attributed to the procedure. Patients were grossly divided into 2 groups: those who had various clinical symptoms attributed to the IVCF and those who were asymptomatic, yet wished to avoid potential filter-related complications or required indefinite anticoagulation because of presence of the device.

The justification for IVCF use is based in the concept that various patient groups at risk for VTE who cannot receive anticoagulation will benefit from a mechanical barrier that will prevent potentially fatal PE. Although societal guidelines differ in their approach to IVCF use, consensus does exist that IVCF should be used in patients who have an acute VTE and cannot receive adequate dose anticoagulation. In addition, when anticoagulation has clearly failed in patients with acute VTE, IVCFs are indicated as well. Still, the increased use of IVCF is not supported by high-quality evidence. To date, there have been no studies that randomized patients with VTE to receive either an IVCF or anticoagulation, no studies that compared patients at risk for PE who receive an IVCF or other modes of VTE prophylaxis, and no proof that placement of IVCFs prolong life or lower mortality rates in broad patient populations. Despite less than robust data to support their use, patients are routinely offered IVCF if they present with poor cardiopulmonary reserve, a free-floating iliocaval DVT, and are planned for surgical pulmonary embolectomy or before catheter directed therapy for proximal DVT. Filters are even occasionally used in high-risk patients in conjunction with anticoagulation, implying the imperfection of standard anticoagulant therapy. More recently, analysis of population data has shown that IVCF may be useful in unstable patients with massive PE. Actually, the most commonly reported indications for filter insertion as presented in a comprehensive summary of all the available IVCF-related literature published until 2010 included an absolute contraindication to anticoagulation (48%), failure of adequate anticoagulation (7%), and prophylaxis without PE or DVT in clinical scenarios deemed to place patients at high risk for VTE (17%). Thus, for many common clinical situations in which IVCF are being used, there is lack data or consensus on the efficacy of these devices.

Surprisingly, retained IVCF-related complications are another area of uncertainty. Clearly, IVCFs are associated with complications including filter migration or embolization, strut fracture, and penetration into adjacent structures, thrombosis, lower extremity edema, post-thrombotic syndrome, DVT, and recurrent PE. However, data about the risk factors and timeline of these complications have actually not been
adequately evaluated to date. In our experience, derived from 758 retrievable IVCF during a median follow-up of 342.0 [81.5–758.0] days, indwelling IVCF-related complications occurred in 17.7% of patients. Mean time to complication was only 32 [13.0–116.8] days and, importantly, there were nearly no complications after 6 months have elapsed since the time of implantation (Weinberg et al, unpublished data, 2013).

The need for anticoagulation for retained filters has also not been studied in well-designed prospective randomized trials. The common convention suggests that anticoagulation should be administered only according to the original VTE-related indication, regardless of filter status. Prolonged anticoagulation administration in patients with retained filters has potential advantages such as reducing filter-related IVC thrombosis and minimizing recurrent PE and carries an increased risk of bleeding. In our aforementioned experience, early and late complications occurred at similar rates, whether or not anticoagulation was administered.

Although Kuo et al. should be commended for describing a novel technique for the removal of difficult to retrieve IVCF, and although they report relatively few complications, there are some unorthodox elements in their approach that need to be highlighted. First, the authors used thrombolytic agents when they encountered thrombus within the filter in 3 patients. Although they do not report any major bleeding as a consequence, this measure does raise the question of necessity compared with added risk. Given the prolonged time of indwelling filters, there was likely no urgency to filter retrieval. Thus, perhaps a trial of anticoagulation would have achieved thrombus resolution with lower hemorrhagic risk. Second, the authors describe their strategy of using stent-grafts in cases in which there was accidental caval perforation. Stent-grafts have been studied most commonly in the arterial system, and there is little objective data about their use in the low flow venous system. Thus, their use may have replaced a potentially benign IVCF with a potentially thrombotic implant and may add a potential long-term consequence of this technique.

As noted by the authors, there are some other inherent limitations to their study. Specifically their technology is not Food and Drug Administration approved for the indication of IVCF retrieval and, although it was safe to use, this was in the hands of a group of clinicians particularly skilled in this technique. Thus, paradoxically, their evident expertise is a source for potential bias for clinicians less versed in using this technology for these purposes.

In these series, many patients were asymptomatic. Although retrieval in symptomatic patients cannot be easily disputed, filter removal in asymptomatic patients is less straightforward. Retrieval may not have been necessary in several of these patients. A control group in which filters were left indwelling without retrieval attempts would have allowed the reader to draw meaningful clinical conclusions about the value of a challenging filter retrieval. It is likely that most of these patients would have probably never experienced any filter-related complications because the filters were indwelling for prolonged periods by the time the study took place.

Kuo et al. summarize their impressive experience with this novel technology and draw conclusions about its efficacy and safety in aiding in the extraction of difficult to retrieve IVCF. Innovative use of laser catheter retrieval may indeed have a place for those symptomatic patients in whom IVCF retrieval is deemed clinically important and in whom more conventional attempts have failed. Nonetheless, other conclusions can actually be drawn from this same experience. First, and foremost, these series reinforce the fact that IVCF should be inserted only when indicated and retrieved as soon as possible. Although the authors contend that as many as 60% of filters cannot be retrieved, modern series point to much higher retrieval rates, especially if retrieval attempts are performed early after implantation. In our experience, retrieval success was 87.9% and, in another modern report, >80% of filter retrieval attempts were successful. It follows that a more pressing issue is actually improving on patient surveillance to minimize patients being lost to follow-up, therefore resulting in missed opportunities for filter retrieval. It has been shown that implementation of systematic methods for patient follow-up will improve filter retrieval rate. Furthermore, limiting IVCF to those patients who can truly benefit from them may also improve patient outcomes. To ensure appropriate patient selection before insertion, a thorough consultation should be performed and consideration should be given to advantages and disadvantages of the procedure. Preferably, patients should be involved in the decision-making process, especially when controversy exists. It is our contention that rather than using extreme measures to retrieve IVCF in asymptomatic patients, if retrieval is difficult, filters should usually remain in place. Anticoagulation is probably not needed in asymptomatic patients with retained IVCF once the original indication has passed. Finally, although the decision about the duration of anticoagulation is often paramount, considering the relationships between vascular intervention and medical management is likely more prudent.

Disclosures
M.R. Jaff is a noncompensated member of Data Safety and Monitoring Board in Ekos; a member of the Scientific Advisory Board in Astra Zeneca Pharmaceuticals; and a board member in Vascular Interventional Advances Physicians, a 501(c) 3 not-for-profit education and research organization. Dr Weinberg has no conflict to report.

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Key Words: Editorials ◼ deep vein thrombosis ◼ inferior vena cava filter 
◼ pulmonary embolism ◼ retrieval
Inferior Vena Cava Filters: Truth or Dare?
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doi: 10.1161/CIRCINTERVENTIONS.113.000818
_Circulation: Cardiovascular Interventions_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 1941-7640. Online ISSN: 1941-7632

The online version of this article, along with updated information and services, is located on the World Wide Web at:
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