

The role of an IVC filter retrieval clinic—A single center retrospective analysis

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Abstract

Background: Inferior vena cava (IVC) filter placement still plays an essential role in preventing pulmonary embolism (PE) in patients with contraindications to anticoagulant therapy. However, IVC filter placement does have long-term risks which may be mitigated by retrieving them as soon as clinically acceptable. A dedicated IVC filter clinic provides a potential means of assuring adequate follow-up and retrieval. **Aim:** To assess the efficacy of our Inferior vena cava (IVC) filter retrieval clinic at improving the rate of patient follow-up, effective filter management, and retrieval rates. **Materials and Methods:** During the period of August 2017 through July 2018, 70 IVC filters were placed at our institution, and these patients were automatically enrolled into our IVC filter retrieval clinic for quarterly follow-up. We retrospectively reviewed data including appropriateness for removal at 3 months, overall retrieval rates, removal technique(s) employed, and technical success. **Results:** 62.9% of the potentially retrievable filters were removed during the study period. The technical success of extraction, using a combination of standard and advanced techniques, was 91.7%. Overall, 15% of the patients were lost to follow-up. **Conclusion:** Our findings add to the growing body of literature to support the need for a robust IVC filter retrieval clinic to ensure adequate follow-up and timely retrieval of IVC filters.

Key words: Anticoagulation; Hangman technique; IVC filter; loop snare; pulmonary embolism; retrieval; venous thromboembolism

Introduction

Venous thromboembolism (VTE), which includes both pulmonary embolism (PE) and deep venous thrombosis (DVT), affects approximately 275,000 patients in the United States every year, with an incidence of 1-2 per 1000-person years.^[1] Approximately 25% of these patients will present with sudden death, and 30% of the patients who survive their initial episode will experience VTE recurrence.^[1] Anticoagulation therapy is considered first line therapy for VTE and often initiated immediately after diagnosis.

Patients with VTE and contraindications to anticoagulation, however, may require placement of an Inferior vena

cava (IVC) filter to reduce the risk of pulmonary emboli originating from the lower extremities.^[2,3] Additional indications for IVC filter placement in patients who are amenable to anticoagulation include, sub-massive/massive PE, high risk clots in the lower limbs, and worsening of VTE clot burden after initiating anticoagulation.^[4] In response to 921 reports of adverse events between 2005 and 2010, the Food and Drug Administration (FDA) published a safety communication stating “Physicians and clinicians placing IVC filters are responsible for the ongoing care of patients with retrievable IVC filters and should consider removing the

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filter as soon as protection from pulmonary embolism is no longer needed".^[5] Short-term filter placement in select patients has been demonstrated to be associated with decreased mortality.^[6] Risks associated with long-term IVC filter placement include, but are not limited to, IVC thrombosis, penetration of the IVC wall, filter migration, and filter fracture.^[7] Therefore, it is imperative to choose the appropriate patients for IVC filter placement and follow them clinically in order to remove the filter when it is no longer needed.

That said, retrieval rates remain notoriously low in the overall population, ranging from 1.2% to 34.9% in multi-center analyses^[6-10] and approximately 16.1%–41.6% in single-center analyses.^[11,12] Removal rates have been increasing,^[13] but not sufficiently enough to ensure filter removal in all patients who no longer have indications for an IVC filter.

A dedicated IVC filter clinic was initially established at our institute in 2012. Patient tracking was enhanced by information technology improvements to our electronic medical record in 2017. Herein, we aim to evaluate our experience 12 months into our improved implementation via a retrospective review of our placement/retrieval data in comparison to the national average. We will also review technical considerations regarding filter retrieval.

Materials and Methods

This retrospective study was approved by the Institutional Review Board with permission to perform chart review and a waiver of written informed consent. All consecutive patients with filters placed from August 2017 through July 2018 were reviewed to determine the filter retrieval rate in eligible patients. All patients had at least three months of follow-up at the time of data analysis. Data collection included reason for placement, procedural details, filter removal status and, if applicable, reasons why the filter was not removed.

All patients who received an IVC filter had a "return to clinic" order placed at time of placement and were automatically scheduled for 3-month follow-up. During this visit, bilateral lower extremity Doppler ultrasound was routinely performed in order to assess clot burden/progression. If for some reason the interventional radiologist (IR) determined that the filter needed to stay in longer, the patient was placed in our "continued follow up" list to be reviewed at a later date. All updates regarding filter management were either documented as a separate clinical visit note or recorded as addenda in the initial status-post placement IR consultation note to ensure that the data was easily accessible, and the timeline was both clear and intact.

Statistical analysis

Associations between filter type, dwell duration, filter tilt, and filter location were compared using the two tailed Fisher's exact test for categorical data with $\alpha = 0.05$.

Filter retrieval techniques

Standard technique

Most filters placed during this period were Günther Tulip [Cook Medical, Bloomington, IN] and the Option Elite [Argon, Plano, Texas] filters. The retrieval procedure was generally performed under conscious sedation using midazolam and fentanyl. Almost always, the internal jugular vein was used for the retrieval. Once the retrieval sheath [Cook Medical, Bloomington, IN] was above the filter, a venogram [Figure 1A] was performed to exclude IVC thrombus. If the IVC was clear, the snare that is provided with the retrieval kit was advanced through the sheath and was used to grasp the filter hook [Figure 1B]. Once secured with the snare, the sheath was advanced to collapse the filter [Figure 1C] and the filter was pulled out by exerting gentle traction on the snare wire. A post procedure IVC venogram was performed to look for any complications and confirm complete filter removal.

Wire and loop snare technique

The wire and loop snare technique has been described by Rubenstein.^[14] In this technique, a 16F × 45 cm sheath [Cook Medical, Bloomington, IN] was used for access into the internal jugular vein. A 5 F reverse-curve catheter was placed in IVC, below the level of the filter and was used to direct a 0.035-inch glide wire [Terumo Medical Corp, Somerset, NJ] through filter legs [Figure 2A], ensuring that the glide wire tip courses cephalad from underneath the filter apex and between the struts. A snare was then introduced via the sheath and was used to grasp the leading end of the glide wire and externalize it. Once the wire is externalized, gentle traction was applied to pull the filter away from the IVC wall and position it more centrally. The sheath was then advanced over the filter apex [Figure 2B] so

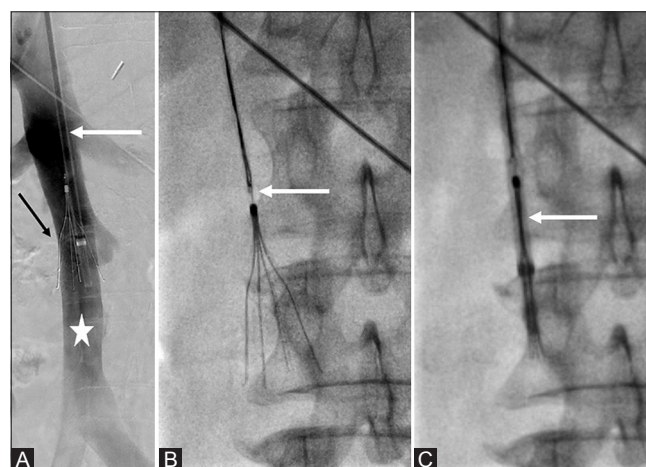


Figure 1 (A-C): (A) Standard loop snare technique for IVC filter retrieval. Venogram through the sheath in the IVC (white arrow) showing a patent IVC (star) with a centrally located filter (black arrow) and no evidence of thrombus within it. (B) Standard loop snare technique for IVC filter retrieval. The snare has engaged the filter hook (white arrow). (C) Standard loop snare technique for IVC filter retrieval. The filter with the hook engaged is enclosed within the sheath (white arrow) and subsequently retracted outside the body

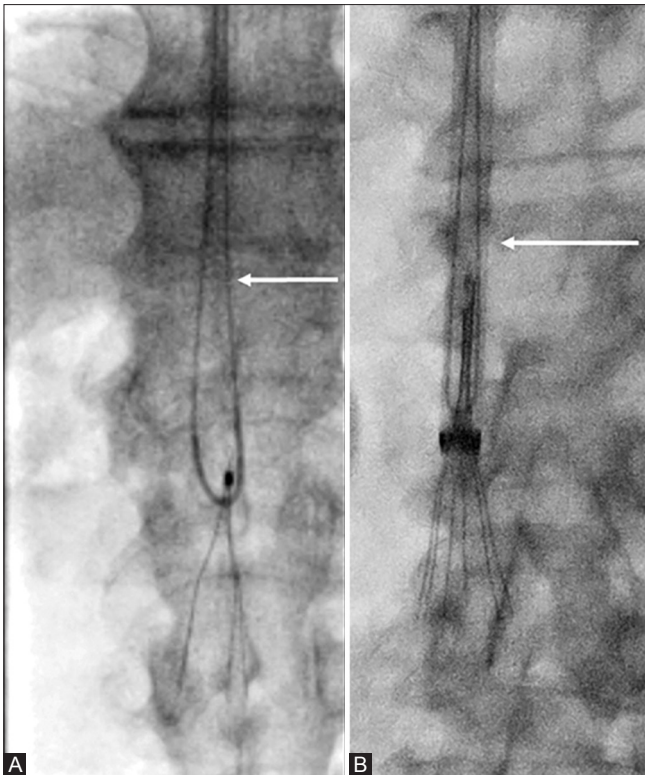


Figure 2 (A and B): (A) Loop snare and wire technique. A wire loop (white arrow) is formed passing the glide wire below the filter apex using a reverse curve catheter and a snare. (B) Loop snare and wire technique. Once the loop passes below the apex and the wire is externalized, gentle traction is applied while advancing the sheath (white arrow) over the filter

that the filter could be collapsed and removed. Attention to the course of the glide wire is of utmost importance with this technique, making sure the glide wire courses immediately beneath the filter apex, without engaging the struts. If the struts are engaged, external traction will deform the struts and cause the filter to acquire a transverse position, thereby worsening the orientation for retrieval [Figure 3].

Hangman technique

If the filter hook is firmly embedded in the IVC wall [Figure 4A], it may not be possible to draw the filter to the center of the IVC by the loop snare and wire technique. However, the hangman technique^[15] modifies the loop snare technique by passing the wire loop between the filter neck and IVC wall as opposed to below the filter apex. As with the loop snare and wire technique, the 16-F × 45 cm sheath [Cook Medical, Bloomington, IN] was used. A 5-F reverse curve catheter is advanced through the sheath and positioned adjacent to [Figure 4B], but not between the filter struts. After that, an angled 0.035-inch Glidewire (Terumo Medical Corp, Somerset, New Jersey) is introduced through the catheter and guided in between the filter neck and the IVC wall [Figure 4B]. The leading end of the wire is then snared and externalized [Figure 4C]. Once externalized, a cranially directed tug is applied to the wire to shear the fibrous tissue

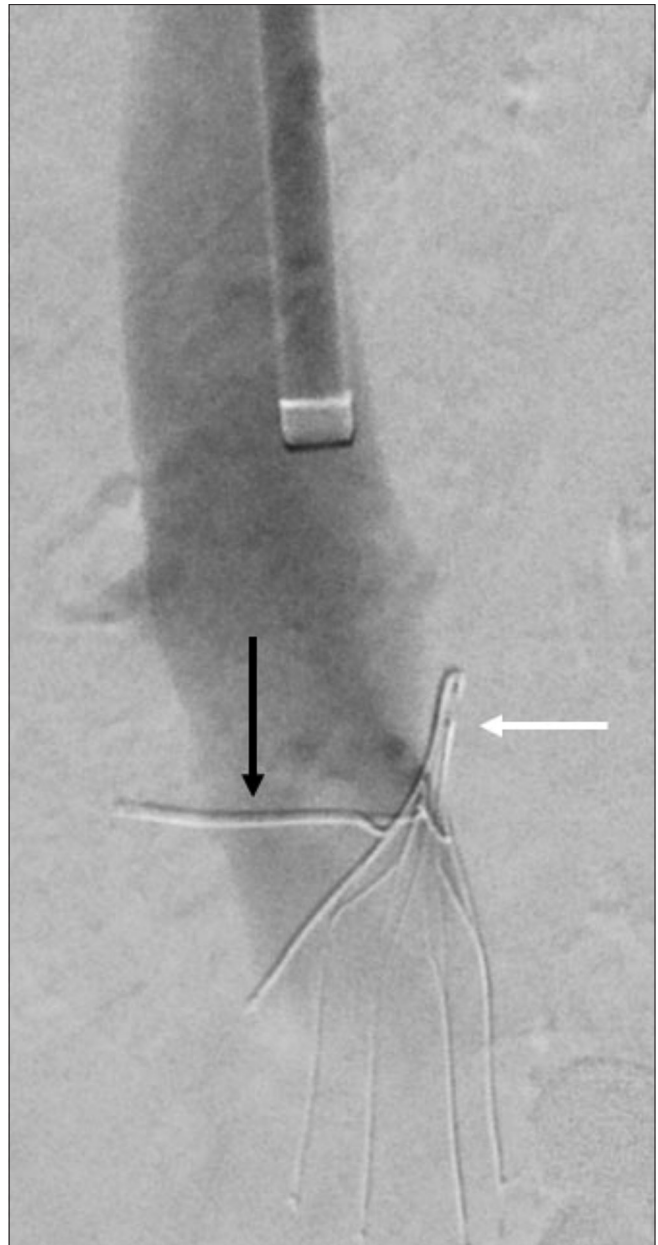


Figure 3: Venogram showing a markedly tilted Option filter (white arrow). One of the legs has been deformed (black arrow) from a previous attempt at retrieval using the loop snare and wire technique. Despite penetration of the vessel wall by one of the filter's legs, there were no complications associated with removal

between the filter hook and the IVC. Once the filter hook is freed from the wall, the filter can be snared [Figure 4D], and removed as in the standard technique.

Research ethics standards compliance

This original article was completed under an institutional review board approved protocol. The IRB number was 2004777. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Results

During this study period, 70 IVC filters were placed at our institution (37 males, 33 females. Mean age was 65 ± 15.4 years). The most common indications for placement included DVT in the setting of intracranial hemorrhage or recent neurosurgery (26), extensive clot burden posing an immediate risk for PE (13), and DVT associated with gastrointestinal (GI) bleed (11) [Table 1]. Of these 70 patients, 22 underwent successful retrieval at our institution, 2 were referred, (per patient request) to outside hospitals for removal, 2 failed retrieval despite advanced techniques and 44 filters were left in place without an attempt at retrieval [Figure 5]. 18 of the filters were retrieved using the standard loop snare technique, while 4 filters were retrieved with the hangman/wire loop and snare (advanced) techniques.

The overall IVC filter retrieval rate for all the filters placed during the study period was 31.4% (22/70). Of the 24 patients who had a filter retrieval procedure, 2 patients failed attempted retrieval despite advanced techniques. This resulted in a 91.6% technical success rate with filter retrieval. Filter retrieval was not attempted in 46 patients due to a variety of clinical scenarios [Figure 6]. 58.7% (27/46) were either deceased or discharged to hospice, 15% (7/46) were lost to follow-up (which includes two patients referred, as per their request, to outside facilities for removal without subsequent verification of filter extraction), 8.7% (4/46) were pending reevaluation, 8.7% (4/46) had poor clinical status, 6.5% (3/46) had long-term contraindications to anticoagulant therapy, and 2.2% (1/46) demonstrated persistent/increased clot burden.

The effective retrieval rate was defined as IVC filters retrieved/(total IVC filters eligible for retrieval). During the follow-up, only 35 of the 70 filters were available for potential removal. Of these 35, 22 were removed, yielding an initial retrieval rate of 62.9%. An additional

4 cases (11.4%) were pending re-evaluation at the time of data analysis. Of the patients pending reevaluation, one was going to be reevaluated after scheduled surgery, one had a short-term contraindication to anticoagulation therapy,

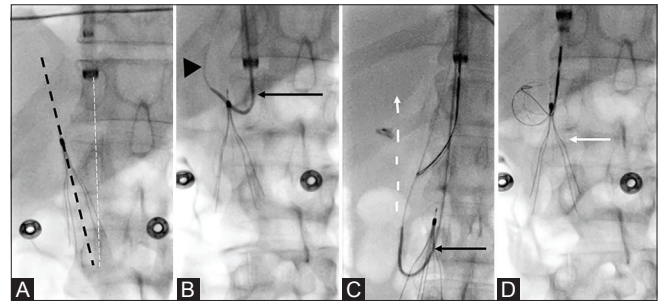


Figure 4 (A-D): (A) Hangman technique. A spot radiograph shows the off centered filter (black dotted lines) relative to the sheath (white dotted line). (B) Hangman technique. A reverse curve catheter was placed adjacent to the filter with the leading end at the level of the filter neck (black arrow), and an angled 0.035-inch Glide wire (black arrowhead) was directed between the filter neck and IVC wall. (C) Hangman technique. The leading end of the wire was snared and withdrawn through the sheath creating a loop through between the filter hook and the IVC wall (solid black arrow). A cranially directed tug was applied (dashed white arrow). (D) Hangman technique. The embedded hook was released thus centering the filter (white arrow) which allowed for subsequent retrieval using the standard snare technique

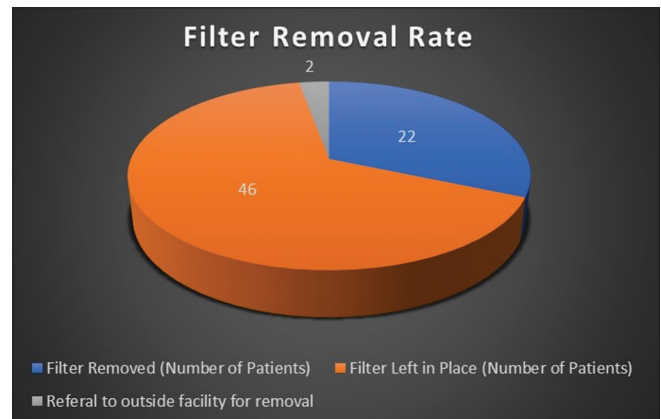


Figure 5: Pie chart showing filter retrieval rate

Table 1: Indications for IVC Filter placement during the study period

IVC filter placement indication	Percentage (n/N)
Neurological Bleed/Injury/Surgery	37% (26/70)
DVT with high risk of PE	19% (13/70)
GI Bleed	16% (11/70)
Hematuria	6% (4/70)
Hemarthroses/hematoma/superficial bleeding	4% (3/70)
Platelet abnormalities (qualitative and quantitative)	4% (3/70)
Hemoptysis	3% (2/70)
Rapidly Dropping Hemoglobin	3% (2/70)
Retroperitoneal Hemorrhage	3% (2/70)
Planned Surgery (non-neurological)	1% (1/70)
Aortic Stenosis/aortic Dissection	1% (1/70)
Oropharyngeal Cancer	1% (1/70)
Draining Abdominal Wound	1% (1/70)

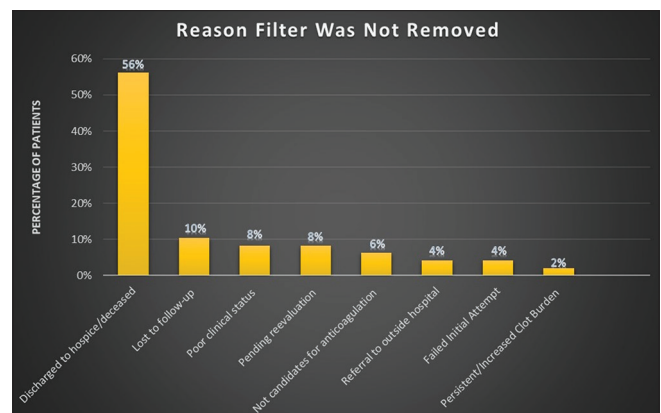


Figure 6: Histogram showing reasons for non-retrieval of filters. The majority was due to hospice admission or passing away before retrieval

one had an elevated D-dimer (with primary care physician recommending later follow-up), and one inconsistently responded to phone calls from our office. The remaining 9 filters were not removed due to loss of follow-up (5), referral to an outside hospital without confirmation of removal (2), and failed retrieval (2). Among the 22 filters removed, 16 were retrieved within the initial 6 months after placement, and 6 were removed after 6 months of placement [Figure 7]. Of the 16 removed in the first 6 months, 4 were retrieved within 3 months of placement.

The rate of successful retrieval were not statistically significant for Gunther and Option Elite filters (94% (17/18) vs 83% (5/6), respectively, $P = 0.446$), dwell duration less than 90 days and more than 90 days (100% (4/4) vs 86% (18/21), respectively, $P = 1.000$), tilt angle less than 10° compared to 10° or larger (89% (16/18) vs 86% (6/7), respectively, $P = 1.000$), and infrarenal placement compared to other locations (94% (16/17) vs 75% (6/8), respectively, $P = 0.231$) [Table 2].

Discussion

Our results are consistent with previous studies, which showed a 52% removal rate with automated clinic scheduling.^[16] Establishment of a multidisciplinary task force consisting of representatives from a variety of fields, such as vascular surgery and interventional radiology, along with implementation of patient education, an IVC filter registry, and a filter coordinator increased retrieval rates to 54%,^[17] while establishment of a secure IVC database improved another institution's removal rate from 52.9% to 72.9%. When utilizing this database, retrieval decisions were first made 90 days after insertion, and an alert message would appear within the database if a patient lacked a documented plan after this time-period.^[17]

Our reported rate of IVC filter removal (62.9%) is consistent with previously reported retrieval rates after establishment of a dedicated clinic.^[16-18] Of the 22 filters removed, 16 (72.7%) were removed within the first 6 months post placement with the remainder removed within the following 6 months. In addition to retrieving the IVC filters in eligible patients, we also provided adequate three-month follow-up to 93% of our patients as only 5/70 patients were lost to follow-up. Further, our results indicate relative parity in procedural success regardless of filter type, dwell duration, filter tilt or filter placement.

Implementing an IVC filter removal clinic not only improves patient care, but also enhances economic viability of IVC filter placement. Dowel *et al.* calculated a net loss of 482.37 U.S. dollars with permanent IVC filter placement, a net loss of 535.34 U.S. dollars with retrievable IVC filter placement without removal, and a net profit of 742.34 U.S. dollars with retrievable IVC filter placement and removal.^[19]

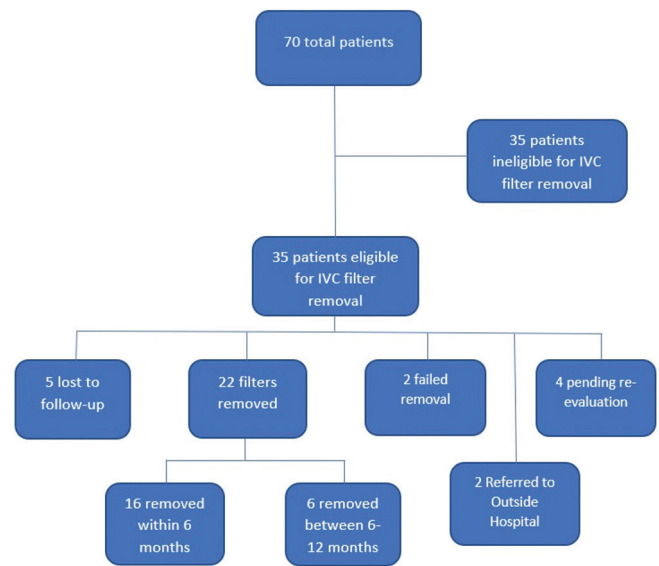


Figure 7: Breakdown of IVC filter placement and retrieval during the study

Table 2: Reported percentage of successful retrieval with respect to the type of filter, duration, tilt and location

	Successful retrieval	P
Filter type		
Gunther	94% (17/18)	0.446
Option elite	83% (5/6)	
Dwell duration		
< 90 days	100% (4/4)	1.000
90 days or longer	86% (18/21)	
Tilt angle		
< 10°	89% (16/18)	1.000
10° or larger	86% (6/7)	
Location of Filter		
Infrarenal	94% (16/17)	0.231
Renal or Suprarenal	75% (6/8)	

Therefore, successful patient follow-up plays an essential role in both improving outcomes and ensuring economic sustainability of IVC filter placement.

Approximately 15% (7/46) of the patients eligible for filter retrieval were lost to follow-up, despite multiple attempts to contact these patients after filter placement. This number includes two patients who elected for removal at outside hospitals, but removal was not confirmed after referral to these facilities. In order to ensure comparable care of our patients from neighboring communities, continued contact with IR and primary care physicians should be pursued in the future. Furthermore, multiple modes of updated contact information should be acquired before discharge after placing IVC filters.

The limitations of our study include its retrospective design, small sample size, and single institute cohort. Additionally,

we did not look at our filter retrieval rates prior to 2012, before our clinic was established. Therefore, we do not have a pre-IVC filter clinic removal rate at our institution to serve as a control. Instead, we compared our data with other published reports.

Conclusion

Our study adds to the growing body of literature that supports the establishment of an IVC filter clinic to ensure filter retrieval, once these devices are no longer indicated.

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Abbreviations

Inferior Vena cava- IVC, venous thromboembolism-VTE, Pulmonary embolism-PE, Deep venous thrombosis (DVT) Food and drug administration-FDA

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Nil.

Conflicts of interest

There are no conflicts of interest.

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