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Original Article

Observations on failed retrieval of optional inferior vena cava filters

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ABSTRACT

Purpose: To evaluate causes of failed optional inferior vena cava filter (IVCF) retrievals.
Methods: Single-center retrospective study.
Results: IVCF retrievals were attempted in 26/211 (12%) patients at a mean 42.9 days. There were 9 failures (all OptEase) due to: inability to snare the hook ($n=5$), noncollapsible IVCF ($n=3$), and unusual procedural pain ($n=1$). Median duration of retrieved IVCFs was 31 days compared to 53 days for failures ($P<.05$). IVCFs aligned with the IVC's cephalocaudal axis were retrieved in 13/16 cases, while misaligned IVCFs were retrieved 4/10 cases ($P<.05$).
Conclusion: Filter duration and misalignment were significantly associated with retrieval failures.

1. Introduction

Inferior vena cava filters (IVCFs) are an important means of treatment or prophylaxis in appropriate patients with a diagnosis or high risk for venous thromboembolism (VTE). Patients with therapeutic indications include those with previous failure of anticoagulation, an existing pulmonary embolism (PE), or a specific contraindication to anticoagulation. Prophylactic placement of IVCF is controversial but used for a variety of indications that include severe trauma patients, elderly patients undergoing orthopedic procedures with anticipated prolonged period of poor mobility, and patients with hypercoagulable states, such as certain malignancies [1,2].

Long-term adverse events reported in association with IVCF placement such as increased venous stasis or thrombosis, filter migrations, embolizations, perforated IVC, and filter fractures have fostered the development of optional IVCFs [3]. Optional IVCFs allow for the short-term benefits of a filter to capture emboli without its potentially associated long-term complications. Failure to retrieve these filters leaves the patient with a permanent device implanted that exposes them to potential long-term adverse effects. Failure rates for retrieval of optional IVCFs range from 0% to 72% [4–8]. The purpose of this study is to review our experience with retrieval of optional IVCFs. Factors that may predict filter retrieval success or failure are presented and discussed.

2. Materials and methods

This was an institutional review board-approved retrospective study conducted in a large tertiary care university hospital center. All patients who had optional IVCF placement in a 68-month period were included. IVCFs were placed by the interventional radiology service in the angiography suite. Filter types used included OptEase (Cordis Endovascular; a Johnson & Johnson Company, Warren, NJ, USA) and Günther-Tulip model filters (Cook Medical, Bloomington, IN, USA). The common femoral veins, internal jugular veins, and upper extremity veins (brachial, basilic, and cephalic) were used for filter placement access, which was dictated by the patient's condition. In cases where the right or left common femoral veins were not amenable to use (e.g., bilateral deep venous thromboses [DVTs]), the right or left jugular vein was accessed using ultrasound guidance. If the access to internal jugular veins was not feasible (e.g., C-spine not being clear with stabilizing collar), the right or left upper extremity veins were used [9]. Venacavograms were performed in all cases to evaluate the presence of an IVC thrombus, IVC anomalies, and IVC diameter, and to document the level of the renal

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veins. The IVCFs were deployed below the renal veins. Filter position and alignment were documented using standard spot views.

Screening duplex ultrasonography was performed at follow-up visits to rule out the presence of DVTs prior to retrieval attempts. After screening duplex ultrasonography revealed no DVTs, patients were scheduled for IVCF retrieval. The Günther–Tulip filter retrieval kit (Cook Medical), consisting of a 60-cm 11-F sheath and a 15-mm snare with a shaft of 80 cm in length, was used for IVCF retrieval. Accesses for filter removal were the right internal jugular and both common femoral veins. Venacavograms were performed prior to IVCF retrieval to ensure that there were no thrombi within the deep veins or the IVC and no thrombus load within the filter itself.

Parameters evaluated included the type of IVCF placed, duration of placement, alignment, IVCF indication, and retrieval success and failure. IVCF alignment/misalignment (tilted) was evaluated by venacavogram and was defined by contact of either the cephalad or caudal filter pole with the wall of the IVC. IVCF duration of filter placement and alignment/misalignment were correlated with filter retrieval success or failure using the Fisher Exact test and Wilcoxon rank sums test, respectively. A P value of less than .05 was considered statistically significant. All analyses were performed using SAS 9.13 software (SAS Institute, Cary, NC, USA).

3. Results

3.1. Baseline demographics

During the study period, optional IVCFs were placed in 211 consecutive patients (130 males, 81 females, average age 49.41 years). Indications for IVCF placement were therapeutic in 121 patients and prophylactic in 90 patients. Therapeutic indications included DVT, 91 patients; PE, 25 patients; and DVT/PE concurrently, 5 patients. Prophylactic indications included trauma, 83 patients (severe trauma requiring intensive care unit support in 51 patients, head injury in 8 patients, pelvic fracture in 7 patients, quadriplegia/paraplegia in 7 patients, vertebral fractures in 7 patients, and femoral fracture in 3 patients); sepsis, 3 patients; and cancer, seizure, history of PE, burns, 1 patient each. Most IVCFs were OptEase ($n = 204$; 97%) and Günther–Tulip accounted for the remaining 7. All were technically successfully without immediate periprocedural complications. Filter access sites and alignment are demonstrated in Table 1.

3.2. Retrieval failures

IVCF retrieval was attempted in 26/211 (12%) patients. Of the 26 attempted IVCF retrievals, 17 were successfully retrieved (65%) and 9 were unable to be retrieved (35%). Average time from IVCF placement to retrieval for all filters placed was 42.9 days with a range of 6 to 162 days. The median duration of successfully retrieved filters was 31 days as compared to those that were not retrieved, 53 days ($P = .0483$). Most IVCF retrieval attempts were accessed by the right common femoral vein (24/26; 92%). In the remaining 2 cases, the left common femoral vein and right internal jugular vein were accessed and both of these retrieval attempts were unsuccessful. IVCFs aligned with the IVC's cephalocaudal axis were retrieved in 13 of 16 (81.25%) cases, while misaligned (tilted) IVCFs were retrieved in 4 of 10 cases (40.00%; $P = .0461$). These data are summarized in Table 2.

Inability to snare the hook of the OptEase IVCF caused 5 (56%) patient retrieval failures. In these cases, the IVCF was tilted with the caudal end of the filter and its hook abutting against the caval wall. Retrieval failure occurred in 3 (33%) patients with prolonged duration of filter insertion due to the OptEase IVCF failing to collapse within the sheath. In these cases, the IVCF hook was snared and removal was attempted. However, despite using a great amount of force in retracting the filter, it would not fully collapse within the 11-F sheath and the noncollapsible IVCF was left in place. In these cases, the average length of filter duration in filters that failed to be collapsed was 69.6 days with a range of 59 to 84 days. Unusual pain felt by the patient during attempted IVCF removal was responsible for 1 (11%) IVCF retrieval failure; the filter was successfully snared and partially retracted into the sheath. However, hooks on the cephalad pole of the filter appeared to be embedded into the caval wall (Fig. 1). IVCF retrieval was aborted when attempting to dislodge the filter caused excruciating lower back pain to the patient.

4. Discussion

In the present study, duration of filter placement and misalignment of the IVCF within the IVC were significantly associated IVCF retrieval failure. Longer indwelling times for IVCFs have been shown to have lower likelihood of retrieval [7,10,11]. In the present study, a median time difference of 22 days was significantly associated with IVCF retrievability. Misaligned IVCFs were also more likely to be associated with retrieval failures, which is consistent with prior reports [12]. Perhaps the most alarming finding of our study was the high proportion of patients lost to follow-up after optional IVCF placement (185/211; 88%).

In recent years, retrieval of optional IVCF has become a point of emphasis by the US Food and Drug Administration (FDA). In response to accruing data on complications of long-indwelling IVCFs, the FDA issued a warning in 2010 recommending providers to consider filter removal as soon as the protection against and embolic event was no longer needed [13]. These complications, including filter migrations, embolizations, and perforated IVCs, are associated with longer-than-necessary indwelling times or poor rates of retrieval. The majority of these complications occur after 30 days of filter placement. A systematic review of 37 studies with over 6500 patients with optional IVCFs found that 93% of filter-related complications occurred 30 days or later after placement and only a mean 34% of IVCFs were retrieved (range 12%–45%) [12].

In the same time period that filter retrieval has come under scrutiny by the FDA, professional medical organizations have advocated to establish robust evidence for the indications and efficacy of IVCFs. In 2009, the Society of Interventional Radiology led an initiative to form a multidisciplinary research consensus panel to address the paucity of prospective studies of IVCF placement. As reported by Kaufman et al. [14], the panel observed the difficulty in designing studies and trial due to the rapidly evolving commercially available IVCFs. By the time a trial has been designed and approved or in the time it takes to accrue data, the IVCF of interest in a proposed study may no longer be available. The

Table 1
Alignment of IVCFs by insertion access site

Access site	Aligned (percentage)	Misaligned	Total
Right common femoral vein	94 (97%)	3	97
Left common femoral vein	26 (46%)	31	57
Right internal jugular vein	40 (89%)	5	35
Left internal jugular vein	–	–	–
Right upper extremity vein	11 (100%)	0	11
Left upper extremity vein	1 (100%)	0	1
Total	172 (82%)	39	211

Table 2
Characteristics of successful and failed IVCF retrievals

	Retrieved filters	Retrieval failures	Total	P value
Access site				
Right common femoral vein	17	7	24	–
Left common femoral vein	0	1	1	–
Right internal jugular vein	0	1	1	
Alignment				
Properly aligned	13	3	16	–
Misaligned/tilted	4	6	10	–
				.0461
Median retrieval time (days)	31	53	N/A	.0483
Total	17	9	26	–