Improving Inferior Vena Cava Filter Retrieval Rates: Impact of a Dedicated Inferior Vena Cava Filter Clinic

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PURPOSE: To test the hypothesis that an inferior vena cava (IVC) filter clinic increases the retrieval rate of optional IVC filters.

MATERIALS AND METHODS: Patients who had optional IVC filters placed at the authors’ institution between January 2000 and December 2008 were identified and retrospectively studied. A dedicated IVC filter clinic was established at this institution in January 2009, and there is a comprehensive database of prospectively acquired data for patients seen in the IVC filter clinic. Patients were chronologically classified into preclinic and postclinic groups. The number of optional filters retrieved and failed retrieval attempts were recorded.

RESULTS: In the preclinic and postclinic periods, 369 and 100 optional IVC filters were placed. Median (interquartile range) number of optional filters placed per month for preclinic and postclinic periods was 3 (range 2–5) and 10 (range 6.5–10.5) ($P < .001$). Retrieval rates in preclinic and postclinic periods were 108 of 369 (29%) and 60 of 100 (60%) ($P < .001$). The median time to filter retrieval in the postclinic group was 1.5 months (95% confidence interval 1.2–1.8). The number of failed retrieval attempts in preclinic and postclinic periods was 23 of 369 (6%) and 5 of 100 (5%) ($P = .823$).

CONCLUSIONS: The retrieval rate of optional IVC filters at this institution was significantly increased by the establishment of a dedicated IVC filter clinic. This retrieval increase is not related to a decrease in technical failures but more likely relates to more meticulous patient management and clinical follow-up.


Abbreviations: DVT = deep venous thrombosis, IVC = inferior vena cava, PE = pulmonary embolism

VENOUS thromboembolism affects 1 to 2 individuals per 1,000 annually in the United States, resulting in significant morbidity and mortality (1). Anticoagulation is the preferred treatment for deep venous thrombosis (DVT) and thromboembolic disease. In certain cases, anticoagulant therapy for venous thromboembolism is contraindicated, results in complications, or fails to protect patients adequately from thromboembolism. These patients can be treated with insertion of inferior vena cava (IVC) filters, which function to prevent clinically significant pulmonary embolism (PE) by trapping venous emboli (2,3).

Two basic types of IVC filters are available in the United States: permanent and optional (or retrievable). Permanent filters have been used in clinical practice since the 1970s and are placed in patients with a long-term need for mechanical prophylaxis against PE and absolute contraindications to anticoagulation (4). Optional filters, which have been available since the late 1990s, are designed to be retrieved or left in place after the temporary risk of PE or contraindication to anticoagulation has resolved (5). If retrieved, optional filters offer the theoretical benefit of fewer long-term complications associated with permanent IVC filters, such as increased risk of subsequent DVT (6,7).

The availability of optional filters has altered the practice patterns for IVC filters, with a shift to these devices and lowering of thresholds for filter placement (5,8). Optional filters are now placed for prophylactic indications in patients who are at increased risk for development of clinically significant PE and unable to undergo primary prophylaxis, such as in the setting of trauma (3). As a result, the number of filter placements in the United States has increased steadily.
each year with prophylactic indications now accounting for more than half of all filter placements (8–11). In clinical practice, only 20% of optional filters are ever retrieved (5,8,9,12–14).

In recognition of the increasingly important role that optional IVC filters are playing in the treatment of thromboembolic disease and the historically low retrieval rates of these devices, we established a dedicated IVC filter clinic to improve management and follow-up of patients with optional IVC filters. In this study, we test the hypothesis that a dedicated IVC filter clinic increases the retrieval rate of optional IVC filters.

MATERIALS AND METHODS

Study Design

Under institutional review board approval, we identified and retrospectively studied patients who had optional IVC filters placed at our institution by interventional radiology between January 2000 and December 2008. We established a dedicated IVC filter clinic at our institution in January 2009. Data were collected prospectively for patients with optional IVC filters placed by interventional radiology between January 2009 and January 2010. IVC filter cases were chronologically classified into preclinic and postclinic groups.

Indications for and placement of filters were in accordance with the Society of Interventional Radiology (SIR) guidelines (15,16). Optional filters were placed in these patients with the intent of their retrieval after the need for mechanical prophylaxis against PE expired.

Device Descriptions

Four commercially available optional IVC filters were placed at our institution during the study period. These included the (a) Celect filter (Cook, Bloomington, Indiana), (b) G2 filter (Bard Peripheral Vascular, Tempe, Arizona), (c) Günther Tulip filter (Cook, Bloomington, Indiana), and (d) OptEase filter (Cordis, Miami Lakes, Florida). The type of filter placed was at the discretion of the interventional radiologist performing the procedure.

Optional Filter Placement

Patients were prepared for the procedure according to the standard of care at our institution, and all implant procedures were performed according to the instructions for use. Briefly, after the administration of local lidocaine, the right internal jugular vein was the preferred access site. Following an inferior vena cavagram, the IVC filter was typically deployed in an infrarenal position. Patients were discharged or returned to their hospital room immediately after the procedure.

Optional Filter Retrieval

Optional filter retrieval was attempted when deemed clinically appropriate by the investigating interventional radiologist. If a patient was an inpatient for any reason at the time that filter retrieval was deemed clinically appropriate, the retrieval procedure was performed during the inpatient stay. IVC filter removal was typically done under conscious sedation with intravenous midazolam and fentanyl. After the administration of local lidocaine, right internal jugular vein or right common femoral vein access was typically obtained depending on the type of indwelling filter. Following an inferior vena cavagram, the IVC filter was captured and removed through a vascular sheath. Patients were discharged or returned to their hospital room after 1 hour of observation per the conscious sedation protocol at our institution.

Pre-Inferior Vena Cava Filter Clinic Patient Data

In the preclinic period, we did not use a standard methodology to coordinate the removal of implanted optional devices. Referring physicians would often contact an interventional radiologist when their patients were candidates for retrieval.

Inferior Vena Cava Filter Clinic Data

We established a dedicated IVC filter clinic at our institution in January 2009, including a separate, comprehensive IVC filter clinic database. Our IVC filter clinic included a clinical nurse coordinator working with a dedicated interventional radiologist at our preexisting interventional radiology clinic. The IVC filter clinic was an added clinical responsibility for the nurse coordinator and interventional radiologist. The nurse coordinator updated a prospective IVC filter clinic database in Excel spreadsheet format (Microsoft, Redmond, Washington) of all patients who had IVC filters placed by interventional radiology. Before any filter placement, the interventional radiologist consulted with the referring physician and confirmed the indication for and type of filter to be placed (ie, permanent or optional). All optional filters were placed with the intent of their retrieval after the need for mechanical prophylaxis against PE expired. After filter placement, the nurse coordinator and interventional radiologist monitored patients with optional filters on the clinic database and coordinated filter removal with the patients’ physicians when clinically indicated. Referring physicians were typically contacted 2 to 3 weeks after filter placement by the dedicated interventional radiologist to discuss the possibility of IVC filter removal or the timing of removal. This communication was repeated until the filter was removed, or the decision was made to leave the filter as a permanent device.

The first 15 patients in the postclinic group were seen in our clinic before the retrieval procedure to review the procedure and answer any related questions. We reevaluated the need to see patients in the office before retrieval. We decided that it was most efficient to see patients in our clinic only if their retrieval procedure was predicted to be complicated (eg, prolonged indwell time) or on patient request. Otherwise, the retrieval procedure was typically scheduled via telephone, and the procedure and any related questions were reviewed on the day of the procedure.

Adverse Events

Complications were categorized based on the SIR Clinical Practice Guidelines and Reporting Standards (15–17). Minor complications were managed conservatively. Major complications required therapy with or without brief hospitalization or pro-
longed hospitalization or resulted in permanent adverse sequelae or death.

**Statistical Analysis**

We recorded the number of optional filters placed and retrieved and the number of failed retrieval attempts of optional filters for the preclinic and postclinic groups. Categorical variables between the two groups were compared using χ² test or Fisher exact test. Continuous variables between the two groups were compared using Mann-Whitney tests.

The median time to filter retrieval was calculated in the postclinic population using the Kaplan-Meier method (time-to-endpoint analysis) (18). An endpoint was defined as successful removal of the optional IVC filter. P values < .05 were considered significant.

**RESULTS**

Table 1 presents the proportion of optional IVC filters placed each year. During the study period, 469 optional IVC filters were placed at our institution. The demographics are presented in Table 2.

IVC filter cases were chronologically classified into preclinic and postclinic groups. In the preclinic period, 369 of 469 (79%) optional filters were placed, with a mean of 46 IVC filters per year (range 33–77). In the postclinic period, 100 of 469 (21%) optional IVC filters were placed. The median (interquartile range) number of optional filters placed per month for the preclinic and postclinic periods was 3 (range 2–5) and 10 (range 6.5–10.5) (P < .001). The types of optional IVC filters placed are presented in Table 2.

**Optional Filter Retrieval**

The optional filter retrieval rates are presented in Table 2. The retrieval rates in the preclinic and postclinic periods were 108 of 369 (29%) and 60 of 100 (60%) (P < .001).

Preclinic Period.—Optional filter retrieval rate in the preclinic period was 29% (108 of 369). No optional filters were placed before 2001.

Postclinic Period.—Of the optional filters placed in the postclinic period, 60% were retrieved. Of 100 filters, 40 (40%) were not retrieved because of the following reasons: 33 (82.5%) were kept permanent, 5 (12.5%) had failed retrievals, 1 (2.5%) was lost to follow-up, and 1 (2.5%) is still being followed by the IVC filter clinic. The median time to filter retrieval was 1.5 months (95% confidence interval 1.2–1.8). This is shown in the Kaplan-Meier curve presented in the Figure.

**Failed Optional Filter Retrieval**

Failed retrieval attempts were categorized as technical failures of the retrieval procedure. The number of failed retrieval attempts in the preclinic and postclinic periods was 23 of 369 (6%) and 5 of 100 (5%) (P = .823).

For the 23 patients in preclinic group, limited data were available for retrieval failures. There were five patients in the postclinic period whose optional filters could not be removed because of in-growth into the IVC. Two of the devices were Günther Tulip filters, and three were Celect filters. The times to attempted retrieval in these five patients were 1.8 months, 2.2 months, 2.4 months, 2.9 months, and 3.7 months (mean 2.6 months). Further attempts at retrieval were not made, and these filters were left in place as permanent devices.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Proportion of Optional Inferior Vena Cava Filters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>Year</td>
</tr>
<tr>
<td>Pre-IVC filter clinic</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>2001</td>
</tr>
<tr>
<td></td>
<td>2002</td>
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<tr>
<td></td>
<td>2008</td>
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<tr>
<td>Overall</td>
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ICV = inferior vena cava.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Comparison of Pre-IVC Filter Clinic and Post-IVC Filter Clinic Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (range)</td>
<td>58 (15–100)</td>
</tr>
<tr>
<td>Gender</td>
<td>1.00†</td>
</tr>
<tr>
<td>Male</td>
<td>196 (53%)</td>
</tr>
<tr>
<td>Female</td>
<td>173 (47%)</td>
</tr>
<tr>
<td>Type of filter</td>
<td>&lt;.001‡</td>
</tr>
<tr>
<td>Bard</td>
<td>13 (3.5%)</td>
</tr>
<tr>
<td>Tulip</td>
<td>339 (92%)</td>
</tr>
<tr>
<td>Celect</td>
<td>16 (4.2%)</td>
</tr>
<tr>
<td>OptEase</td>
<td>1/369 (0.2%)</td>
</tr>
<tr>
<td>Optional filter retrieval</td>
<td>&lt;.001†</td>
</tr>
<tr>
<td>Yes</td>
<td>108 (29%)</td>
</tr>
<tr>
<td>No</td>
<td>261 (71%)</td>
</tr>
<tr>
<td>Failure of optional filter retrieval</td>
<td>.823‡</td>
</tr>
<tr>
<td>Yes</td>
<td>23 (6%)</td>
</tr>
<tr>
<td>No</td>
<td>346 (94%)</td>
</tr>
</tbody>
</table>

ICV = inferior vena cava.

* Calculated using Mann-Whitney test.
† Calculated using χ² test.
‡ Calculated using Fisher exact test.
Adverse Events

Limited data were available on complications occurring in the preclinic period. In the postclinic period, 2 of 100 (2%) patients experienced complications related to their IVC filters. One complication was categorized as major, and the other was categorized as minor.

Major Complication.—The major complication occurred in a 70-year-old woman with a history of DVT and PE who had a prophylactic Celect filter placed before surgery, when she would be off anticoagulation. The patient developed a symptomatic PE postoperatively with her filter in place. At presentation, the patient’s filter was found to be tilted despite being well positioned after initial placement. The tilted filter was removed and replaced with another Celect filter with the intent of retrieval when the patient resumed therapeutic anticoagulation. The patient’s symptoms improved, and she experienced no clinical sequelae.

Minor Complication.—The minor complication was an infection at the right internal jugular vein access site of a male patient after successful removal of his optional filter. The infection resolved with outpatient antibiotic therapy.

DISCUSSION

We significantly increased the retrieval rate of optional IVC filters at our institution by establishing a dedicated IVC filter clinic. In the preclinic period, less than one third of optional IVC filters placed by interventional radiology were retrieved. In the postclinic period, we improved our retrieval rate to 60%. The number of failed retrieval attempts was similar in both periods, suggesting that the improved retrieval rate was not related to a decrease in technical failures.

Although all optional filters were placed with the intent of their retrieval, our low preclinic retrieval rate was similar to rates reported in the literature (5,9,12). Before establishment of our clinic, we did not use a standard methodology to coordinate the removal of implanted optional devices. Consequently, a common reason that an optional filter was left in place as a permanent device in the preclinic group was loss to follow-up.

By establishing a dedicated IVC filter clinic, we addressed many of the shortcomings associated with management of optional IVC filters at our institution. Referring physicians are now routinely contacted 2–3 weeks after optional filter placement to discuss the possibility of filter removal or the timing of removal, transferring all of the responsibility of retrieval away from the referring physicians and patients to the interventional radiologist.

We created a database to monitor actively all patients with optional filters. Our comprehensive database also details our failed retrievals and adverse events. We included much of the data from our postclinic group in this study to show the utility of our database and contrast it to the paucity of data that we have on our preclinic group. To date, our postclinic complication rate of 1% is acceptable. Even with an improved retrieval rate of 60% in our IVC filter clinic practice, there is still room for additional improvement. As we move forward, we plan to use our database to learn how to improve patient selection for optional IVC filters and increase our retrieval rate further.

Expansion of the traditional accepted indications for IVC filter placement and the use of prophylactic IVC filters have altered the practice patterns for IVC filter placement, with a shift toward using more optional filters (8). Because less than half of optional filters historically are retrieved, improved selection and management of patients with these devices is crucial. Optional filters that are not retrieved carry the same long-term complication risks as permanent devices, including an increased risk of subsequent DVT, filter migration or embolization or both, symptomatic penetration of the filter outside the IVC, filter fracture, and IVC stenosis or occlusion (5,7,8,19,20). Additionally, because reimbursement by third-party payers is the same for permanent and optional filters, more expensive optional filters that are kept as permanent devices result in greater technical costs for a practice than cheaper permanent filters (21). Janne d’Othée et al (21) developed a cost analysis model to show that the use of optional versus permanent devices for filter placement is financially advantageous for an institution only if 41% of the filters are eventually removed.

The patient population served by an institution also influences the indications for and potential conversion of optional filters from retrievable to permanent devices (5,9). At centers where optional filters are placed for PE prophylaxis in trauma patients, the patient population is traditionally younger with historically difficult follow-up—likely contributing to the low retrieval rates at these institutions (14). Recently, Ko et al (22) developed an institutional protocol for prospective monitoring of prophylactic optional IVC filters in trauma patients.
protocol included a physician assistant on the trauma service who compiled a prospective optional filter database and coordinated the removal of these filters either during the inpatient stay or as an outpatient. This protocol significantly improved the optional filter retrieval rate from 37% in the preprotocol period to 84% in the postprotocol period.

Our study has several important limitations. First, we collected data on patients in the preclinic group retrospectively. Since 2001, the indications for and placement of optional filters have expanded, but the indications were not always clearly documented. Additionally, the reasons for nonretrieval in the preclinic group were unavailable for many patients because of loss to follow-up. In the postclinic period, the data were collected prospectively and were more complete. Second, there were a smaller number of patients in the postclinic period. It remains to be seen if the postclinic retrieval rate will remain significantly higher than the preclinic rate as the number of filters placed increases.

Third, long-term complication data are lacking on most patients. Two thirds of the optional filters placed in the preclinic group were left in place as permanent devices, but the major and minor complication rates are unknown.

Despite these limitations, our results support the establishment of an optional IVC filter clinic with a clinic database that is actively monitored by dedicated staff. Theoretically, this practice could increase the retrieval rate of optional IVC filters, reduce long-term complication rates, and result in cost savings. Our higher postclinic filter retrieval rate was largely the result of improved patient follow-up; we are now providing more comprehensive postprocedural care for our patients—something we were not doing in the preclinical era.

In conclusion, we significantly increased the retrieval rate of optional IVC filters at our institution by establishing a dedicated IVC filter clinic. This retrieval increase is not related to a decrease in technical failures, but more likely relates to more meticulous patient management and clinical follow-up.

References