Rates and Predictors of Plans for Inferior Vena Cava Filter Retrieval in Hospitalized Patients

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BACKGROUND: Use of inferior vena cava (IVC) filters has been increasing over time. However, because of the increased risk of deep vein thrombosis with permanent filters, placement of retrievable filters has been recommended. Little is known about the factors associated with planned retrieval of IVC filters.

OBJECTIVE: To describe rates and predictors of plans to retrieve IVC filters in hospitalized patients.

DESIGN: We identified all IVC filter placements from 2001–2006 at an academic medical center and reviewed medical charts to obtain data about patient characteristics, filter retrieval plans, and retrieval success rates. Multivariable logistic regression was used to identify independent predictors of planned filter retrieval in patients with retrievable filters.

RESULTS: Out of 240 patients who underwent placement of retrievable IVC filters, only 73 (30.4%) had documented plans for filter retrieval. Factors associated with lower rates of planned filter retrieval included a history of cancer [adjusted odds ratio (OR) and 95% confidence interval 0.2 (0.1–0.5)] and not being discharged on anticoagulants [OR 0.1 (0.1–0.3)]. In addition, 36 (21.6%) of patients without retrieval plans had no contraindications to retrieval. Of the 62 patients who underwent attempted filter retrieval, 25.8% of filters could not be successfully removed.

CONCLUSIONS: Only 30.4% of patients who underwent placement of a retrievable IVC filter had documented plans for filter removal. Although most patients had justifiable reasons for filter retention, 21.6% of patients had no clear contraindications to filter removal. Efforts to improve rates of filter retrieval in appropriate patients may help reduce the long-term complications of IVC filters.

KEY WORDS: inferior vena cava; filter retrieval; deep vein thrombosis.

Abbreviations

IVC	inferior vena cava
SD	standard deviation
VTE	venous thromboembolism

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INTRODUCTION

Inferior vena cava (IVC) filters are percutaneously placed devices used to prevent pulmonary embolism. The most widely accepted indications for IVC filter placement include venous thromboembolic disease with contraindications to anticoagulation treatment, recurrent venous thromboembolism despite adequate anticoagulation, and recurrent pulmonary embolism complicated by pulmonary hypertension.[1–4] Expanded, more controversial indications for filter use include limited cardiopulmonary reserve, thrombectomy/thrombolysis of deep venous thrombosis, prophylaxis in patients at high risk for deep venous thrombosis from trauma or surgery, and patients with deep venous thrombosis who have cancer, burns, or who are pregnant.[1,2]

While one randomized trial has shown that IVC filter placement concurrent with full-dose anticoagulation decreases the risk of subsequent pulmonary embolism in the short term, the placement of IVC filters also significantly increases the long-term risk of deep venous thrombosis (20.8% at 2 years with IVC filter placement vs. 11.6% without, and 35.7% vs. 27.5% at 8 years).[5,6] Long-term complications associated with IVC filter placement are particularly important to consider because IVC filter placement has increased dramatically over the last 2 decades.[7]

In recent years, IVC filters that can be subsequently retrieved have been developed. These filters can be left in place during the acute, high-risk phase of developing a pulmonary embolism and can be removed when the indication for filter placement is no longer present. During removal, a catheter is advanced to the site of the filter in the vena cava and attaches to a small hook or knob at the end of the catheter, allowing for retrieval. Manufacturers generally recommend retrieval between 10 and 14 days after placement;[8] however, one article described retrievable filters with dwell times ranging from 9 to 150 days.[3] Single-center retrospective studies examining IVC filter retrieval in medical-surgical patients have shown retrieval attempt rates ranging from 14–45%,[9–12] whereas prospective case series to demonstrate the feasibility of IVC filter retrieval have reported much higher retrieval attempt rates, ranging from 56–99%.[13–18]

Several studies have examined procedural factors associated with retrieval failure in patients undergoing retrieval,[19,20] but studies have not examined the clinical factors that influence whether or not IVC filter retrieval is attempted. Because filters are not benign interventions and can lead to long-term adverse outcomes, identifying characteristics that predispose patients to retention of a placed filter is important. We therefore conducted a retrospective cohort study to describe retrieval rates of IVC filters and identify risk factors associated with lack of planned filter retrieval.

METHODS

We identified all hospitalized patients who had an IVC filter placed by the Section of Interventional Radiology at the University of California, San Francisco (UCSF) Medical Center during a 5-year period from January 1, 2002 to December 31, 2006. Patients were identified using a registry of patients who had undergone IVC filter placement kept by the Section of Interventional Radiology, as well as by searching billing and administrative databases for patients who had an *International Classification of Diseases, Ninth Revision, Clinical Modification* billing code for "interruption of the vena cava" (code 38.7). Detailed procedure notes were available for all subjects, and electronic discharge summaries were available for all but two of the individuals.

All available electronic admission notes, discharge summaries, transfer summaries, and radiology procedure notes were reviewed and data collected using a formal chart abstraction tool. Data were collected on patient demographics (age, sex, primary language, and race/ethnicity), clinical comorbid conditions, indication, type and placement of the IVC filter, and finally, whether there was a documented plan to remove the filter. In the subgroup of patients who had retrievable filters placed and who were discharged alive, we reviewed all subsequent UCSF radiology procedure notes to determine whether or not the filter was removed at a later date. In patients who underwent attempted filter retrieval, radiology procedure notes were reviewed to obtain information on retrieval success rates and complications during retrieval.

For patients with retrievable filters who did not undergo filter retrieval, we reviewed the chart to determine whether there were documented contraindications to removing the filter. We considered patients who had contraindications to filter removal as those with limited life expectancy (metastatic cancer, hospice), a contraindication to anticoagulation, or those who were at persistent high risk for pulmonary embolism despite anticoagulation.

Statistical Analyses

We first described general characteristics of individuals who underwent filter placement. Next, we restricted the analysis to patients who had retrievable filters placed and were discharged alive, performing bivariate comparisons between patient characteristics and documentation of a plan to retrieve the filter. T-tests were used for continuous variables and chi-squared tests for categorical variables. Multivariable logistic regression models were developed to identify independent predictors of having a documented plan for filter retrieval. Candidate variables for the multivariable analyses were those that on bivariate analyses were significant at $p<0.2$. We then used a backward elimination selection process with a significance level of 0.05 to select the final covariates in the multivariable model. All analyses were performed using SAS Software, version 9.0 (Cary, NC). This study was approved by the UCSF Committee on Human Research Institutional Review Board.

RESULTS

We identified 393 patients who underwent placement of an IVC filter during the study period. In five individuals, more than one filter was placed, and in these situations we used only data from the first IVC filter placement in the analysis. The mean age was 60.5 years, 49.4% were female, and the majority of filters (84.7%) were placed because of prior or acute venous thromboembolism (Table 1). Two hundred eighty filters (71.2%) were of retrievable type, while 103 were non-retrievable, and 10 were of unknown type. The proportion of filters placed that were retrievable increased from 13.3% of filters in 2002 to 94.5% in 2006 ($p<0.001$). The inferior jugular vein was the most frequent venous access point (62.6%), and most filters were placed infrarenally (96.7%). None of the filter placement procedures had any documented immediate complications. Fifty-four patients (13.7%) died during the hospitalization.

Plans for IVC Filter Retrieval

We examined plans for retrieval in the 240 patients who had known retrievable-type filters and survived to discharge. A total of 73 (30.4%) individuals had a documented plan for IVC filter retrieval. No filter retrievals were attempted in patients without a documented plan for retrieval. Plans for filter retrieval were the lowest in patients aged ≥70 years (Table 2). Being discharged home was associated more often with a plan for retrieval compared to those who were discharged to skilled nursing or acute care facilities (Table 2).

After multivariable adjustment, factors that were independently associated with having a documented plan for filter retrieval included age <50 years, a history of venous thromboembolism, and where the filter was placed as prophylaxis for a surgical procedure. Factors that were associated with a decreased likelihood of planned filter retrieval included not being discharged on anticoagulants and a history of cancer (Table 3).

Among the 167 patients with retrievable filters who survived to discharge and did not have a plan for filter retrieval, 36 (21.6%) had no documented contraindication to removing the filter. Patients admitted to non-internal medicine services were more likely to lack a documented contraindication for filter removal (27.8% in surgical services and 25.0% in other services, as compared to 6.5% of patients admitted to the general medicine service, $p=0.01$). People aged 50–69 years were also more likely to lack a documented contraindication for filter removal (31.8% compared to 11.1% in those younger than 50 years and 9.3% in those aged ≥70 years, $p=0.003$). We did not run multivariable analysis in this subgroup because of the small size of the sample.

Table 1. Characteristics of 393 Patients Who Underwent IVC Filter Placement

	Patients undergoing IVC filter placement
	N=393
	N (%) or mean±SD
Age (mean years±SD)	60.5 ± 15.5
Age	
<50 years	89 (22.6)
50–69 years	190 (48.3)
≥70 years	114 (29.0)
Female	194 (49.4)
Race	
White	261 (66.4)
Black	28 (7.1)
Latino	15 (3.8)
Asian-American/ Pacific Islander	49 (12.5)
Other/unknown	40 (10.2)
Language	
English	325 (82.7)
Spanish	14 (3.6)
Chinese	14 (3.6)
Other	9 (2.3)
Unknown	31 (7.9)
Admitting service	
General medicine	120 (30.5)
Surgical[a]	215 (54.7)
Other[b]	58 (14.8)
Type of filter placed	
Retrievable	280 (71.2)
Non-retrievable or unknown filter type	113 (28.8)
Primary indication for filter placement	
VTE, anticoagulation contraindicated	294 (74.8)
VTE, on anticoagulation or unspecified	39 (9.9)
High risk for VTE from surgery	28 (7.1)
Other	32 (8.1)
Comorbid medical conditions	
History of malignancy	203 (51.7)
Prior VTE	87 (22.1)
Hypertension	109 (27.7)
Coronary artery disease	41 (10.4)
Congestive heart failure	30 (7.6)
Chronic lung disease	35 (8.9)
Length of stay (mean days ± SD)	22.5 ± 24.7
Anticoagulation at discharge[c]	
None	232 (59.0)
Warfarin only	53 (13.5)
Enoxaparin plus warfarin	36 (9.2)
Enoxaparin only	46 (11.7)
Disposition	
Home	211 (53.8)
Skilled nursing facility/ rehabilitation center	95 (24.2)
Other acute care facility	32 (8.2)
Death	54 (13.8)

IVC = inferior vena cava, SD = standard deviation, VTE = venous thromboembolism
[a]*Surgical services were: general, cardiothoracic, head and neck, gynecologic, transplant, neurosurgery, orthopedics, vascular, and urology*
[b]*Other services were: cardiology, cancer service, gynecology, pediatrics, and neurology*
[c]*Information on anticoagulation use at discharge was missing for 26 individuals*

Table 2. Characteristics of 240 Patients Who Underwent Placement of Retrievable IVC Filters and Were Discharged Alive

	Plan to remove filter, N=73	No plan to remove filter, N=167	P value
	N(%) or mean±SD	N(%) or mean±SD	
Age (mean years ±SD)	55.4±16.7	60.5±15.2	0.02
Age			0.03
<50 years	28 (38.4)	36 (21.6)	
50–69 years	31 (42.5)	88 (52.7)	
≥70 years	14 (19.2)	43 (25.8)	
Female	39 (53.4)	80 (47.9)	0.43
Race			0.75
White	54 (74.0)	118 (70.7)	
Black	4 (5.5)	10 (6.0)	
Latino	1 (1.4)	6 (3.6)	
Asian-American/ Pacific Islander	5 (6.9)	17 (10.2)	
Other/unknown	9 (12.3)	16 (9.6)	
Language			0.42
English	63 (86.3)	141 (84.4)	
Spanish	1 (1.4)	6 (3.6)	
Chinese	1 (1.4)	4 (2.4)	
Other	4 (5.5)	3 (1.8)	
Unknown	4 (5.5)	13 (7.8)	
Admitting service			0.64
General medicine	19 (26.0)	46 (27.5)	
Surgical[a]	40 (54.8)	97 (58.1)	
Other[b]	14 (19.2)	24 (14.4)	
Primary indication for filter placement			0.004
VTE, anticoagulation contraindicated	46 (63.0)	125 (74.9)	
VTE, on anticoagulation or unspecified	5 (6.9)	18 (10.8)	
High risk for VTE from surgery	15 (20.6)	9 (5.4)	
Other	7 (9.6)	15 (9.0)	
Comorbid medical conditions			
History of malignancy	23 (31.5)	95 (56.9)	<0.001
Prior VTE	30 (41.1)	31 (18.6)	<0.001
Hypertension	26 (35.6)	42 (25.2)	0.10
Coronary artery disease	6 (8.2)	19 (11.4)	0.46
Congestive heart failure	3 (4.1)	12 (7.2)	0.37
Chronic lung disease	5 (6.9)	13 (7.8)	0.51
Length of stay (mean days ± SD)	17.6 ± 21.5	19.6 ± 18.1	0.46
Anticoagulation at discharge[c]			<0.001
None	20 (29.4)	96 (61.9)	
Warfarin only	17 (25.0)	22 (14.2)	
Enoxaparin plus warfarin	16 (23.5)	12 (7.7)	
Enoxaparin only	15 (22.1)	25 (16.1)	
Disposition			0.12
Home	53 (72.6)	98 (58.7)	
Skilled nursing facility/ rehabilitation center	15 (20.6)	53 (31.7)	
Other acute care facility	5 (6.9)	16 (9.6)	

IVC = inferior vena cava, SD = standard deviation, VTE = venous thromboembolism
[a]*Surgical services were: general, cardiothoracic, head and neck, gynecologic, transplant, neurosurgery, orthopedics, vascular, and urology*
[b]*Other services were: cardiology, cancer service, gynecology, pediatrics, and neurology*
[c]*Information on anticoagulation use at discharge was missing for 17 individuals*

IVC Filter Retrieval Rates

Among the 73 patients for whom there was a documented plan to remove the IVC filter, retrieval was attempted in 62 patients, and of these, 46 filters were successfully removed (Table 4).

None of the individuals who did not have a documented filter retrieval plan at the time of placement had attempted filter retrieval at our institution. Among the 16 individuals who underwent a retrieval attempt but where the filter could not be successfully retrieved, the most common reason for failed retrieval was thrombus in the filter (Table 4). There were 11 patients who had documented retrieval plans but did not undergo retrieval attempts. One patient was found to have extensive thrombus around the filter during imaging, and so retrieval was not attempted. Four individuals were transferred to other hospitals before the retrieval could be performed. For 6 individuals, we could not determine the reason for not attempting retrieval.

Table 4. Filter Retrieval Plans in 73 Subjects Who Underwent Placement of a Retrievable Inferior Vena Cava Filter and Had a Documented Plan for Removal

	N (%)
Retrieval attempted	62 (84.9)
Filter successfully retrieved	46
Unsuccessful retrieval attempt	16
Thrombus in filter	9
Unable to snare filter	3
Extensive deep venous thrombosis	2
Filter incorporation into inferior vena cava	1
Right carotid hematoma during procedure	1
Retrieval planned but not performed	11 (15.1)

DISCUSSION

Our study found that only 30.4% of patients who underwent placement of a retrievable IVC filter and who survived to discharge had a documented plan for subsequent filter retrieval. Although most patients had justifiable reasons for filter retention, we found that 21.6% of patients without retrieval plans had no clear contraindications to filter removal. In 62 patients who underwent a filter retrieval attempt, 25.8% of attempts were unsuccessful.

IVC filters are not benign clinical interventions. Complications of filter placement include immediate issues such as problems with filter positioning, filter tilting, and technical malfunctions.[21] In addition, IVC filters increase the risk for later deep venous thrombosis[5,6] as well as rarer complications such as insertion site thrombosis,[22] perforation of the inferior vena cava,[22,23] and filter migration to the heart or lungs.[24,25] These complications highlight the importance of ensuring timely removal of filters in appropriate patients.

Our study found that filter retrieval plans were less likely in patients who had a history of cancer and who were not placed on anticoagulants at discharge, a finding that most likely reflects ongoing contraindications to anticoagulation and the need for continued filter retention. However, we also found than 21.6% of patients without plans for filter retrieval had no clear contraindication to retrieval, and that these patients were more likely to be on non-medicine services and be aged 50–69 years. Knowledge of these risk factors could be helpful in developing strategies to improve the rate of appropriate filter retrieval. Although our study was unable to determine the exact reasons for retaining the filter, it is possible that ambiguity as to which service was responsible for the decision on filter removal contributed. Strategies to improve communication between services, such as by designating the service that placed the filter as responsible for follow-up and retrieval[26] or by tasking nursing staff to help with follow-up plans[27], may clarify role responsibilities and improve plans for filter retrieval. In any case, developing clearer guidelines addressing which patients are appropriate candidates for retrieval and establishing standard lines of responsibility could potentially reduce the rates of inappropriate filter retention. Patients, too, may not always be informed or understand the potential harms of permanent IVC filter placement and should be educated about the importance of appropriate follow-up after filter placement.

In many situations, it may be justifiable to elect not to remove the filter. Such reasons include ongoing contraindications to anticoagulation, large emboli found within the filter or large occlusive thrombus distal to the filter, or poor patient prognosis.[15] The optimal management of these patients in regard to long-term anticoagulation in the presence of an IVC filter is less clear. The proportion of patients in our study undergoing attempted filter retrieval are lower than studies of trauma patients,[28–30] prospective case series to demonstrate IVC filter retrieval feasibility,[13–18] and studies examining medical-surgical patients outside the US.[10–12] However, our rates are comparable to those obtained at another retrospective single-center study of medical-surgical patients at an academic medical center in the US.[9] Finding thrombus within the IVC filter, the most common complication precluding filter retrieval in our study, has been commonly described in other studies.[3,10,16,18,23]

There are several limitations to our study. Patients were identified from a single medical center, limiting generalizability. We lacked consistent long-term follow-up, which limited our ability to identify long-term complications. Our reliance on medical chart review may not have completely captured the entire decision-making process around filter placement, nor completely ascertained the contraindications to retrieval. Variation in the amount of information contained in retrospective patient records could have yielded incomplete information on indications for retention.

Despite these limitations, our study is unique in that it examines the demographic and clinical predictors of plans for IVC filter retrieval. We found that the majority of patients

Table 3. Multivariable Model Identifying Predictors of Planned IVC Filter Retrieval Among 240 Patients Who Underwent Placement of Retrievable IVC Filters and Were Discharged Alive

Characteristic	Adjusted odds ratio and 95% confidence interval
Age <50 years	2.6 [1.2–5.6]
Indication for IVC filter placement	
VTE, anticoagulation contraindicated	Referent
High risk for VTE due to surgery	4.5 [1.4–14.7]
VTE, other	0.3 [0.1–1.2]
Other indication	0.8 [0.2–2.6]
History of cancer	0.2 [0.1–0.5]
History of VTE	2.5 [1.1–5.3]
Not discharged on anticoagulants	0.1 [0.1–0.3]

IVC = inferior vena cava, VTE = venous thromboembolism

undergoing filter placement do not have subsequent plans for filter retrieval, although this decision is justifiable in most of the cases. However, there remains a significant proportion of patients who could be considered for filter retrieval. Efforts to improve the rates of filter retrieval in appropriate patients may help reduce the long-term complications of IVC filters.

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