



Regular Article

Predictors of attempted inferior vena cava filters retrieval in a tertiary care centre

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ARTICLE INFO

Article history:

Received 22 December 2013

Received in revised form 15 May 2014

Accepted 20 May 2014

Available online 29 May 2014

Keywords:

Venous thromboembolism

Deep vein thrombosis

Pulmonary embolism

Inferior vena cava filter

Prevention

Complications

ABSTRACT

Background: Retrieval rates of optional recovery inferior vena cava (IVC) filters in US hospitals range from 11–70%. We conducted a retrospective study in a Canadian tertiary care centre to determine retrieval rates and predictors of filter removal.

Methods: Consecutive patients who had a retrievable IVC filter inserted or removed between January 2007 and December 2010 were identified. Data collected included baseline demographics, indications for filter insertion and removal, documentation of an IVC filter management plan, reasons for non-retrieval, complications, and death.

Results: 275 patients with a median age of 60 years were followed in hospital for a median of 17 patient-days (range 1–876). Indications for filter placement were acute or prior VTE with contraindication to anticoagulation (72.4%), high risk of PE (11.3%) and primary prophylaxis (13.8%). Retrieval was attempted in 165 patients (60%) and was successful in 146 patients (53.1%). The most common reason for failed retrieval was filter thrombus. Predictors of attempted retrieval included documentation of filter plan (odds ratio [OR] 16.7; $p < 0.001$), surgical indication for IVC filter insertion (OR 4.8; $p = 0.002$), age ≤ 70 years (OR 3.8; $p = 0.001$), Hematology service involvement (OR 3.0; $p = 0.006$), and presence of metastatic cancer (OR 0.2; $p = 0.001$). Thrombotic complications occurred in 48 patients, including 3 patients who died of fatal PE.

Conclusion: Our filter retrieval rate is suboptimal. Improvements in follow-up documentation or a dedicated clinical service may help increase retrieval rates.

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Introduction

The gold-standard therapy for venous thromboembolism (VTE) is anticoagulation [1]. However, inferior vena cava (IVC) filters are frequently used in patients with contraindications or as an adjunct to anticoagulation. Development of percutaneous placement methods and retrievable devices has led to a dramatic increase in filter usage over the last four decades. Administrative data from the United States have indicated a 24-fold rise in IVC filter placement between 1979 and 1999 and a 2-fold increase between 1999 and 2008 [2,3].

Despite this widespread use, only one randomized control trial evaluating the efficacy and safety of IVC filters has been published. In the PREPIC trial, filter use in addition to therapeutic anticoagulation resulted in a lower incidence of pulmonary embolism (PE) at the expense of increased recurrent deep vein thrombosis (DVT) [4,5]. At 2-year and 8-year follow-up, there was no reduction in overall venous

thromboembolism (VTE) and no effect on overall survival [4,5]. Furthermore, complications, including insertion site hematoma, filter tilting or improper positioning, filter migration, strut fracture and embolization, or penetration of the IVC can occur in up to 86% of patients and can be associated with fatal consequences [6–10]. In addition, because the filter does not prevent clot formation, up to 30% of patients may develop thrombosis of the IVC or lower limbs [11]. In response to these high complication rates and the variable rates of filter retrieval – ranging from 1.2% in the Medicare population to 70% in tertiary care trauma centres [2, 12–14] – the United States Food and Drug Administration issued a safety alert in 2010 to recommend removal of retrievable filters as soon as possible [15]. To determine if similar rates of filter retrieval occur in Canada and to identify clinical predictors of filter retrieval, we conducted a retrospective study in our tertiary-care, provincial trauma centre.

Materials and Methods

Patient population

All consecutive patients who had an IVC filter placed or removed by the Interventional Radiology service at Vancouver General Hospital, Vancouver, BC between January 1, 2007 and December 31, 2010 were

Abbreviations: VTE, venous thromboembolism; DVT, deep vein thrombosis; PE, pulmonary embolism; IVC, inferior vena cava; OR, odds ratio.

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evaluated for inclusion. Patients were excluded if a permanent IVC filter was placed or if they were transferred from another institution for IVC filter placement. The study was approved by the Institutional Research Ethics Board.

Data collection

Electronic and chart records of all eligible patients were reviewed. Standardized case report forms were used to record demographic information, filter indication, documentation of a management plan for the filter by the clinical service, attempted/successful filter retrieval, reasons for non-retrieval, complications, and death in hospital. Follow-up information was collected on all patients from filter insertion up to the time of hospital discharge. In those with a filter in situ at discharge, filter retrieval data were extracted up to March 2012.

Acute VTE was defined as DVT or PE occurring within three months prior to filter placement. Accepted reasons for not removing the filter included death in hospital, short life expectancy (terminal illness or discharge to hospice), decision to keep the filter in permanently, persistent or permanent contraindication to anticoagulation, or continued high risk of PE despite anticoagulation as determined by the attending physician.

Study objectives

The primary objective of our study is to determine the incidence of attempted and successful filter retrieval. Our secondary objective was to identify clinical predictors of filter retrieval. We also examined the clinical course of patients with IVC filter placement to document: 1) the indications for placement; 2) rate of filter complications; 3) presence of a management plan in the hospital chart; and 4) number of deaths in hospital. A filter management plan was defined as the documentation of an arrangement for filter removal, a decision to make the filter permanent or an indication that there is a persistent or permanent contraindication to anticoagulation.

Statistical analysis

Descriptive statistics are provided for patient and filter demographics. A univariate comparison of prespecified baseline characteristics was performed of patients who did or did not have an attempted filter retrieval. Patient characteristics were compared using two-sided t-tests for continuous variables and chi-square test for categorical variables. Variables which achieved $p < 0.20$ were included in a multivariate analysis using binary logistic regression to determine predictors of attempted filter retrieval. Patients with a limited life expectancy (<90 days) or death in hospital were excluded from the analysis. The resultant predictive model was validated by repeat binary logistic regression of split halves. For patients who underwent more than one filter insertion during our study period, only the first filter placed in each patient was included in our analysis. All statistical analysis was performed using SPSS analytical software. P-values < 0.05 were considered statistically significant.

Results

Patient population and follow-up

Between January 2007 and December 2010, 285 patients who underwent placement or removal of an IVC filter were identified, of which 275 were included in our analysis. Ten patients were excluded because they were transferred from another local hospital for filter insertion ($n = 6$), had received permanent filters ($n = 2$), or had no filter or follow-up information available ($n = 2$). Total duration of follow-up from time of filter insertion to discharge or death in hospital was 8287 patient-days (median 17 patient-days, range 1–876 patient-days). The

charts of all patients with filters in situ at the time of discharge were reviewed in March 2012 for retrieval information; of these 4 cases were not available for follow-up. Thus, total length of follow-up for filter retrieval in our cohort was 110 920 patient-days (median 49 patient-days, range 1–1870 patient-days).

Clinical characteristics of the patients are shown in Table 1. Median age was 60 years and 54.5% of patients were male. The majority of patients (77.5%) presented with an acute DVT/PE, while 18.5% had a history of prior VTE (>3 months prior to filter insertion). Risk factors for the development of VTE included active malignancy, trauma and infection. About one-third of the patients were admitted to each of the medical, surgical or critical care/trauma services. Indications for filter placement and type of filter inserted are summarized in Table 2.

IVC filter retrieval results

Of the 275 patients included, filter retrieval was attempted in 165 patients (60.0%), with an overall successful retrieval rate of 88.5% (146/165). The median IVC filter dwell time in patients with a successful retrieval was 18 days (range 2–483 days). In all 14 patients requiring multiple attempts at retrieval, initial failure to recover the device was secondary to the presence of thrombus within the filter and/or in the IVC. The success rate of retrieval dropped from 92.3% (132/143) after the first attempt to 60.9% (14/23) with ≥ 2 attempts.

In the 110 patients without any attempts at filter removal, reasons for non-retrieval included death in hospital or limited life expectancy ($n = 41$), decision to keep the filter in situ permanently ($n = 22$), persistent or permanent contraindication to anticoagulation ($n = 10$), high risk of PE despite anticoagulation ($n = 5$), and lost to follow-up ($n = 4$). A reason for non-retrieval of the filter was not identified in 28 patients. If we consider only those patients who were eligible for filter retrieval, then our attempted retrieval rate was 85.5% (165/193).

Table 1

Clinical characteristics of patients included in the analysis.

Patients Characteristics	n = 275
Median age (range), years	60 (14–93)
Female gender, n (%)	125 (45.5)
Acute VTE^a, n (%)	213 (77.5)
DVT	75 (27.3)
PE	82 (29.8)
DVT and PE	56 (20.4)
Prior VTE^a, n (%)	51 (18.5)
Malignancy, n (%)	97 (35.3)
Non-metastatic	61 (22.2)
Metastatic	36 (13.1)
Infection requiring antibiotics, n (%)	155 (56.4)
Trauma, n (%)	63 (22.9)
Median length of hospital stay (range), days	23 (1–879)
Admitting service, n (%)	
Medical subspecialty ^b	95 (34.5)
Critical care/trauma services	84 (30.5)
Surgical subspecialty	96 (34.9)
Hematology consultation, n (%)	117 (42.5)
Death in hospital, n (%)	39 (14.2)
Cancer	10 (25.6)
Infection	7 (17.9)
Respiratory failure	7 (17.9)
PE	3 (7.6)
Trauma	2 (5.5)
Intracranial hemorrhage	1 (2.5)
Other ^c	9 (23.1)

DVT, deep vein thrombosis; PE, pulmonary embolism; IVC, inferior vena cava

^a Acute VTE defined as occurring within 3 months prior to filter placement; prior VTE defined as occurring 3 or more months prior to filter placement.

^b Medical subspecialty includes the clinical teaching unit, medical subspecialties and the hospitalist service.

^c Cause of death includes: hepatic failure ($n = 2$), cardiac arrest ($n = 1$), pancreatitis ($n = 1$), bowel perforation ($n = 1$), ischemic brain injury ($n = 1$), complete heart block ($n = 1$), unknown ($n = 2$).

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