

Impact of an inferior vena cava filter retrieval algorithm on filter retrieval rates in a cancer population



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ABSTRACT

Objective: Our primary purpose was to assess the impact of an inferior vena cava filter retrieval algorithm in a cancer population. Because cancer patients are at persistently elevated risk for development of venous thromboembolism (VTE), our secondary purpose was to assess the incidence of recurrent VTE in patients who underwent filter retrieval.

Methods: Patients with malignant disease who had retrievable filters placed at a tertiary care cancer hospital from August 2010 to July 2014 were retrospectively studied. A filter retrieval algorithm was established in August 2012. Patients and referring physicians were contacted in the postintervention period when review of the medical record indicated that filter retrieval was clinically appropriate. Patients were classified into preintervention (August 2010-July 2012) and postintervention (August 2012-July 2014) study cohorts. Retrieval rates and clinical pathologic records were reviewed.

Results: Filter retrieval was attempted in 34 (17.4%) of 195 patients in the preintervention cohort and 66 (32.8%) of 201 patients in the postintervention cohort ($P < .01$). The median time to filter retrieval in the preintervention and postintervention cohorts was 60 days (range, 20-428 days) and 107 days (range, 9-600 days), respectively ($P = .16$). In the preintervention cohort, 49 of 195 (25.1%) patients were lost to follow-up compared with 24 of 201 (11.9%) patients in the postintervention cohort ($P < .01$). Survival was calculated from the date of filter placement to death, when available. The overall survival for patients whose filters were retrieved was longer compared with the overall survival for patients whose filters were not retrieved ($P < .0001$). Of the 80 patients who underwent successful filter retrieval, two patients (2.5%) suffered from recurrent VTE ($n = 1$ nonfatal pulmonary embolism; $n = 1$ deep venous thrombosis). Both patients were treated with anticoagulation without filter replacement.

Conclusions: Inferior vena cava filter retrieval rates can be significantly increased in patients with malignant disease with a low rate (2.5%) of recurrent VTE after filter retrieval. (*J Vasc Surg: Venous and Lym Dis* 2017;5:689-97.)

The annual incidence of venous thromboembolism (VTE) is approximately 0.1% to 0.2% in the general population.¹ However, in cancer patients, the yearly incidence is estimated to be as high as 8%.² The relative risk of cancer alone for VTE compared with healthy controls is estimated to be 4.7 times higher.³ Whereas anticoagulation is the preferred treatment of VTE, contraindications

include ongoing or high risk of hemorrhage, previous failure of anticoagulation, planned or recent surgery, and thrombocytopenia.⁴

Inferior vena cava (IVC) filters are proven to prevent pulmonary embolism (PE) in patients who cannot receive therapeutic anticoagulation,^{5,6} but complications, such as recurrent deep venous thrombosis (DVT), filter migration, and caval wall penetration, are not uncommon.^{7,8} The U.S. Food and Drug Administration recommends that implanting physicians consider removing the filter as soon as anticoagulation or protection from PE is no longer needed.⁹ Patients should be referred for filter removal when the risk-benefit profile favors removal of the filter and the procedure is feasible within the overall context of the patient's health. To address this concern, prior investigators have successfully employed filter retrieval algorithms to increase retrieval rates from 20% to 29% to 59% to 60%.^{10,11} Patient factors that affect filter retrievability include a history of cancer, perioperative primary prevention, safety of anticoagulation, involvement of hematology consultants, age, medical comorbidities, hospital discharge from the intensive care unit, hospital discharge to a long-term care facility or skilled nursing facility, and lack of a filter retrieval plan on discharge from the hospital.^{12,13} Whereas

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algorithms aimed at improving filter retrieval rates have been largely successful, their utility in cancer patients is unknown. Cancer patients are a unique subset of patients who receive filters. Cancer patients with concurrent thrombosis are associated with poor survival outcomes, which may negatively affect filter retrieval rates.¹⁴ Our primary purpose was to assess the impact of an IVC filter retrieval algorithm in a cancer population. Because cancer patients are at persistently elevated risk for development of VTE, our secondary purpose was to assess the incidence of recurrent VTE in patients who underwent filter retrieval.

METHODS

Our retrospective study follows the principles outlined in the Declaration of Helsinki. It was approved by the Institutional Review Board with waiver of consent granted. We identified patients with active malignant disease who received a retrievable IVC filter at our institution from August 2010 through July 2014. Filters were placed in accordance with the guidelines set by the Society of Interventional Radiology, and specific indications for filter placement were recorded.^{15,16} Filter placement was conducted in accordance with each device's instructions for use (Table I).

The preintervention period occurred from August 2010 to July 2012. During this time, filters were removed by request of the referring provider when it was clinically indicated. In August 2012, a quality improvement filter retrieval algorithm was created. One month after filter placement, one interventional radiologist and two physician assistants would assess each patient's candidacy for filter retrieval by information available in the electronic medical record. The risks of the filter were weighed against the estimated future risk of PE. In practice, patients were considered candidates for filter retrieval if they could be managed with anticoagulation or were no longer hypercoagulable and they were expected to survive at least 6 months.¹⁷ The assessment of the patient's prognosis was made by the referring provider. For cases in which there was ambiguity with regard to the appropriateness of filter retrieval (eg, safe resumption of anticoagulation after transient nonlife-threatening hemoptysis while receiving enoxaparin), the case would be discussed with the referring provider and a hematologist. Details of the filter retrieval algorithm are shown in Fig 1. In the algorithm, lost to follow-up represents patients in whom no further contact could be obtained or there were no plans for the patient to return to MD Anderson. If there were no plans for the patient to return to MD Anderson, the patient was called by phone and asked to speak to the caring physician to assess the appropriateness of filter retrieval. The postintervention cohort was composed of patients who received a retrievable filter from August 2012 to July 2014.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective cohort study
- **Take Home Message:** In 396 cancer patients, by use of an inferior vena cava filter retrieval algorithm, retrieval rate increased significantly from 17.3% to 32.8%. Two of 80 patients (2.5%) had recurrent thromboembolism after filter retrieval.
- **Recommendation:** The authors suggest using an inferior vena cava filter retrieval algorithm to improve retrieval rate of filters in cancer patients.

Optional filter retrieval. Patients were seen for consultation before filter retrieval. The goals of patient evaluation before filter retrieval were to assess the patient's risk for continued PE and that retrieval could be performed safely. Importantly, patients with VTE were evaluated for clinical evidence of persistent or worsening symptoms of thrombosis that may indicate a failure or complication of anticoagulation. A focused history and physical examination were performed. Routine laboratory studies included coagulation studies, complete blood counts, and renal function. Patients were then brought back to the interventional radiology suite for filter removal. The patient was prepared in a sterile manner. After local anesthetic administration and administration of sedation, right jugular vein access was established in accordance with the removal protocol for each filter. Inferior venacavography was performed to demonstrate the patency of the IVC and to assess positioning of the filter. Based on the physician's preference, the filter was retrieved with the aid of a snare. For cases in which the filter tip was embedded in the caval wall, the loop-snare technique was employed.¹⁸ If filter retrieval were unsuccessful, patients were either asked to return for a repeated attempt at a later date or referred to a hematologist for long-term filter management. All patients with filters that could not be retrieved were referred to a hematologist to assess appropriateness of long-term anticoagulation. Of note, retrieval with endovascular forceps was recently incorporated into our practice and was not performed for any patient in this study. Patients who underwent successful filter retrieval were followed up longitudinally through the electronic medical record until date of death or at the conclusion of this study. Survival of the patient and incidence of recurrent VTE, as determined by the patient's signs and symptoms and corroborated by imaging, were also calculated.

Statistical analysis. We recorded the number of filters placed and retrieved at our institution in patients who met our inclusion criteria during the specified preintervention and postintervention periods. Continuous variables between the two groups were analyzed using

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