



# Inferior Vena Cava Filter Usage, Complications, and Retrieval Rate in Cancer Patients

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## ABSTRACT

**BACKGROUND:** Venous thromboembolism contributes significantly to morbidity and mortality in cancer patients. Because cancer patients frequently have contraindications to anticoagulation, inferior vena cava filters are commonly placed. The use, safety, and retrieval of retrievable inferior vena cava filters in cancer patients have not been well studied.

**METHODS:** A retrospective review of retrievable inferior vena cava filter use at a tertiary referral hospital was conducted between January 1, 2009 and December 31, 2011. Indications for inferior vena cava filter placement, anticoagulation practices, complications, filter retrieval, and patient outcomes were analyzed for patients with and without active cancer and for cancer subtypes, including localized and metastatic cases.

**RESULTS:** Of 666 patients receiving retrievable inferior vena cava filters during this time period, 247 (37.1%) had active cancer. Of these, 151 (22.7%) had carcinoma, 92 (13.8%) had sarcoma, and 115 (17.3%) had metastatic disease. Overall, follow-up was available for a median of 401.0 (interquartile range: 107.5-786.5) days. Indwelling filter-related complications occurred in 19.8% of patients without cancer and 17.7% with an active cancer ( $P = .50$ ). Patients with cancer were less likely to have the filter retrieved (28.0% vs 42.0%,  $P < .001$ ). In multivariable analysis, cancer was not associated with filter-related complications but was associated with a lower rate of filter retrieval.

**CONCLUSIONS:** In a modern cohort of patients undergoing retrievable inferior vena cava filter placement, active diagnosis of cancer is not associated with a significant increase in filter-related complications, but is associated with a reduced rate of filter retrieval.

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**KEYWORDS:** Cancer; Deep venous thrombosis; Inferior vena cava; Malignancy; Pulmonary embolism

Cancer is an established risk factor for initial and recurrent venous thromboembolism events.<sup>1,2</sup> The risk for venous thromboembolism is further increased by the need for operative intervention, which frequently occurs in patients

with cancer.<sup>3</sup> Furthermore, cancer patients with venous thromboembolism are at significantly increased risk of complications, including bleeding and death, compared with patients without cancer.<sup>4</sup> Anticoagulation, the standard treatment for venous thromboembolism, is often contraindicated in patients with cancer, for a number of reasons, including need for frequent procedures, bleeding,<sup>5</sup> and intracranial metastases. As a result, patients with cancer and venous thromboembolism are frequently considered for inferior vena cava filter placement.<sup>5</sup> According to published guidelines, inferior vena cava filters are indicated in patients with acute venous thromboembolism who cannot receive anticoagulation, or in whom adequate anticoagulation has clearly failed to prevent

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recurrent venous thromboembolism.<sup>6-8</sup> However, the safety of inferior vena cava filter use in patients with cancer who meet these criteria have not been well established.<sup>9-11</sup> The goal of our study was to evaluate the use and safety of retrievable inferior vena cava filters in patients with and without cancer and to correlate their use with meaningful clinical outcomes and complications.

## METHODS

We conducted a retrospective cohort study of all subjects who received retrievable inferior vena cava filters in a tertiary medical center between January 2009 and December 2011.<sup>12</sup> Subjects receiving an inferior vena cava filter (n = 758) were identified through International Classification of Diseases, 9<sup>th</sup> Revision codes 37192 and 37193. Data sources included patient electronic medical records, which reflected inpatient and outpatient care. Due to the small number of patients (n = 7) and distinct clinical scenarios leading to filter placement, patients receiving permanent inferior vena cava filters were excluded. The data were collected in compliance with published reporting standards.<sup>13,14</sup> Patients were further classified by the presence or absence of an active cancer. Cancer was categorized according to the International Classification of Diseases for Oncology, 3rd Edition as a carcinoma, sarcoma, lymphoma, leukemia, myeloma, or mixed type. The primary site and presence or absence of metastases also was recorded. Due to small numbers and distinct clinical characteristics, patients with non-solid malignancies (leukemia, lymphoma, and myeloma) were excluded from further analysis (n = 22). Also, given the small number of subjects with mixed cancer type (n = 4), when a comparison was performed between cancer types and metastatic vs nonmetastatic disease, analysis was restricted to patients with carcinoma or sarcoma. For each patient, the following also was recorded: demographic characteristics, past medical history, indications for inferior vena cava filter placement, inferior vena cava filter retrieval rates, postinferior vena cava filter anticoagulation practices, and patient outcomes. Anticoagulation was defined as “appropriately dosed” if prophylactic dose anticoagulation was administered to a patient who received an inferior vena cava filter for venous thromboembolism prophylaxis, or if therapeutic dose anticoagulation was re-initiated to a patient with a history of venous thromboembolism before inferior vena cava filter placement. Indwelling-inferior vena cava filter-related complications also were documented. Of these, significant complications were defined as inferior vena cava thrombosis, inferior vena cava perforation, inferior vena cava filter migration, or embolization, as well as recurrent deep vein thrombosis and pulmonary embolism. Follow-up

was terminated when one of the following was reached: inferior vena cava retrieval, patient death, or the last available clinical and imaging follow-up. The primary endpoint of the study was recurrent deep vein thrombosis, pulmonary embolism, inferior vena cava thrombosis, or death. The secondary endpoint of the study was recurrent deep vein thrombosis, pulmonary embolism, or inferior vena cava thrombosis. Analysis was restricted to the 688 subjects who were not lost to follow up. Institutional review board approval was obtained for this study.

## Statistical Analysis

Continuous measures were presented as mean  $\pm$  SD or medians with interquartile range, and were analyzed with a 2-sample *t* test or analysis of variance. Fisher’s least significant difference was used for post hoc comparisons among the 3 groups (no cancer, carcinoma, and sarcoma). Variables without a normal distribution were analyzed with a Mann-Whitney *U* test. Categorical variables were summarized using percentages and analyzed with a chi-squared test or Fisher’s exact test. The Kaplan-Meier method was used to perform a time-to-event analysis for time to the primary and secondary endpoints. The curves were evaluated using the log-rank chi-squared test. Logistic regression models were created to determine covariates that associated with inferior vena cava filter retrieval and inferior vena cava filter-related complications. For inferior vena cava filter retrieval, the multivariable model adjusted for the following covariates: age, male sex, type of cancer (none, non-metastatic, metastatic), indication, and initiation of anticoagulation after inferior vena cava filter placement. For inferior vena cava filter-related complications, a multivariable model adjusted for the following covariates: age, male sex, indication, initiation of anticoagulation, and type of cancer (none, nonmetastatic, metastatic).

A 2-sided *P*-value < .05 indicated statistical significance. SPSS 17.0 for Windows (IBM SPSS, New York, NY) was used for data management and analysis.

## RESULTS

A total of 666 subjects, 282 (42.3%) female, 247 (37.1%) with active cancer, and 115 (17.3%) with metastatic disease, were included in the final analysis. Among patients with a diagnosis of cancer, the most frequent type was carcinoma (n = 151, 22.7%) or sarcoma (n = 92, 13.8%). Four patients (0.6%) had mixed cancer. Patients with lymphoma, leukemia, or myeloma (n = 22) were excluded from analysis. The most common locations for cancer were gastrointestinal (n = 50, 7.5%), central nervous system (n = 42, 6.3%), and the musculoskeletal system (n = 42, 6.3%). Follow-up time

### CLINICAL SIGNIFICANCE

- Patients with cancer who receive an inferior vena cava filter (IVCF) are not at increased risk of complication.
- Filter retrieval rates are lower in patients with a diagnosis of cancer.
- Diagnosis of cancer should not be a limiting factor when considering use of an IVCF if otherwise indicated.

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