The Role of Inferior Vena Cava Filters in Cancer Patients

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Abstract

Keywords

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- cancer
- venous thromboembolism
- interventional radiology

Cancer induces a hypercoagulable state and renders patients susceptible to venous thromboembolism. While anticoagulation remains the mainstay of treatment, many of these patients require placement of an inferior vena cava (IVC) filter, often due to a contraindication to or failure of anticoagulation. In this article, the available data on IVC filter usage in cancer patients will be reviewed.

Objectives: Upon completion of this article, the reader will be able to describe the role of the use inferior vena cava filters to prevent venous thromboembolism in cancer patients.

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Bouillaud and Trousseau first reported the association between cancer and thrombosis in the 1800s.¹ It is now recognized as an independent risk factor for venous thromboembolism (VTE),^{2–5} with 2 to 20 times greater risk for VTE versus the general population reported in the literature.^{4,6–8} The etiology of VTE in cancer is multifactorial and may include acquired causes such as tumor-associated activation of the clotting cascade, surgery, radiotherapy, hormone therapy, chemotherapy-induced thrombosis, immobility, tumor-associated mechanical

forces, and the use of central venous catheters.^{4,9–13} Moreover, VTE risk is increased with specific cancer types, including pancreatic, hematologic, gastrointestinal, bladder, brain, renal, bone, gynecologic, testicular, and lung malignancies.^{7,14,15} Additional risk factors such as solid distant metastases,¹⁴ location of the primary tumor site, staging, time after diagnosis, comorbidities, systemic chemotherapy, antiangiogenic therapy, and hospitalization have all been identified as risk factors as well.¹⁶ In addition to the higher baseline risk of VTE in cancer patients, the risk of recurrent VTE is high,^{17–20} and is among the leading causes of death among cancer patients.^{7,21–24}

Anticoagulation and mechanical caval prophylaxis via the use of inferior vena cava filters (IVCF) represent the mainstays of management for VTE in both the general and cancer populations. In this article, we will highlight the obstacles to traditional management of VTE in cancer patients and review the available data and current trends of IVCF use in this population.

Management of Venous Thromboembolism in Cancer Patients

Anticoagulation

Anticoagulation poses a unique challenge in cancer patients, as there is a twofold increase risk of major bleeding events in this population.¹⁹ Risk factors for bleeding include recent

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surgery, thrombocytopenia, platelet dysfunction, acquired von Willebrand disease, coagulation factor deficiencies, intracerebral metastases, and renal insufficiency.^{13,25} Furthermore, anticoagulation regimens tend to be difficult to implement with these patients due to drug interactions,²⁶ alterations in liver metabolism, and nutritional status.⁴ This variety of factors often contributes to states that prevent anticoagulation from being safe or efficacious.

In patients with cancer and acute VTE, low-molecular-weight heparin (LMWH) has been found to reduce the risk of recurrent VTE without increasing the risk of bleeding.²⁷ However, patients managed with LMWH or vitamin K antagonists often experience recurrent VTE^{27–29} and may require either a repeat course of LMWH³⁰ or dose escalation.^{31–33}

There appears to be a role for novel anticoagulants in the treatment and prevention of VTE in cancer patients. Factor Xa inhibitors such as rivaroxaban, apixaban, edoxaban, and the factor IIa inhibitor dabigatran offer potential medium- to long-term anticoagulation with lower risk of bleeding than standard therapy.³⁴ Further studies in this area are warranted.

Inferior Vena Cava Filters

Given the difficulties in initiating and maintaining anticoagulation in cancer patients, mechanical prophylaxis via the use of IVCF is common, with the number of filters implanted in this subset of patients continuing to rise.^{35,36}

The indications for IVCF use in this population can be categorized as “absolute,” “extended,” or “relative.” The absolute indications for placement of an IVCF are typically considered to be contraindication to anticoagulation, complication of anticoagulation, inability to achieve or maintain therapeutic anticoagulation, or recurrent VTE while on adequate anticoagulation.^{37–40} Extended or relative indications, which include massive pulmonary embolism, limited cardiopulmonary reserve, free-floating IVC thrombus, or poor compliance with anticoagulation therapy,^{41,42} are currently among the most common indications for filter placement in cancer patients.

To date, the majority of available data on IVCF use in cancer patients are on permanent IVCF (pIVCF) use in patients with advanced disease,⁴³ where they can be placed without greater rates of complication in cancer patients.⁴⁴ Moreover, pIVCF are effective at preventing VTE in this setting.^{45,46} However, IVCF use has failed to demonstrate a survival benefit in individuals with stage IV disease,^{47–49} except for in those with preserved performance status.⁵⁰ Furthermore, IVCF may negatively impact quality of life in certain populations; for example, IVCF placement in patients with intracranial malignancies has been associated with filter/IVC thrombosis, post-phlebotic syndrome, and recurrent deep vein thrombosis (DVT).⁵¹

The use of pIVCF in cancer patients remains controversial. Just as some studies have described the negative implications of IVCF placement in cancer patients, others have highlighted the benefits that mechanical caval prophylaxis can provide in this population. In their series, Lossef and Barth noted that 14% of patients who had received an IVCF were afforded an

opportunity for therapeutic and palliative invasive procedures to be performed,⁵² suggesting that even though survival benefit may be limited IVCF placement in certain circumstances may actually present an opportunity to improve quality of life.

The availability of retrievable IVCF (rIVCF) has lowered the threshold for filter placement,⁵³ primarily due to the notional benefit of temporary protection from lower extremity DVT-associated PE and retrieval once the indication for mechanical caval prophylaxis has passed. This mitigates the risk of filter-related DVT.⁴⁵ Current trends demonstrate that rIVCF represent the majority of IVC filter placements,³⁵ a trend that is likely mirrored (but not definitively reported) in cancer patients.

Unfortunately, most rIVCFs are not retrieved, with reported retrieval rates as low as 8.5% in certain populations.⁵⁴ Retrieval rates are noted to be significantly lower in patients with cancer^{54,55} and lower still in the setting of metastatic cancer.⁵⁵ This fact poses a potential risk factor for cancer patients, as studies have demonstrated that rIVCFs are associated with significantly higher device-related complications relative to pIVCF, including filter fracture, migration, and perforation.⁵⁶ Furthermore, these complications are positively associated with filter dwell time.^{57,58} Prospective consultation between the interventional radiologist and requesting physician may mitigate these issues.⁵⁹ In addition, Eifler et al developed a mathematical model that identified specific patient factors that negatively impacted retrieval rates, including cancer, advanced age, male gender, and anticoagulation failure.⁶⁰ Use of this type of information can improve patient selection and outcomes.

Specific data on the use of rIVCF in cancer patients are sparse. In a retrospective review of 337 patients, Mikhail et al demonstrated that the rate of VTE following filter implantation was low and in line with previously published studies on pIVCF in cancer patients. They also noted that survival rates were low in their population, and that the retrieval rates were less than 2%.⁶¹ Abtahian and colleagues also performed a retrospective review and reported similar findings, although these authors noted a higher retrieval rate (28%).⁶² Indeed, the analysis of 646 consecutive cancer patients by the authors of this article has demonstrated that individuals with metastatic disease have significantly lower retrieval rates than cancer patients with limited disease, and are twice as likely to have a retrievable filter remain as a permanent device (OR: 1.99, 95% CI: 1.07–3.68, $p = 0.03$). These findings, along with the elevated risk of device-related, dwell time-dependent complications associated with rIVCF, suggest that these devices likely play a limited role in patients with advanced stage cancer.

rIVCF may play a role in patients with early-stage disease and preserved performance status. Blom and colleagues noted the highest risk of VTE within the first few months after the diagnosis of malignancy.⁶ Furthermore, patients with less advanced disease often undergo invasive procedures where anticoagulation is not feasible; in this setting, rIVCF can be placed both in patients with active VTE or as periprocedural prophylaxis.

Conclusion

Cancer patients are at higher baseline risk of VTE and complications from anticoagulation. When anticoagulation is ineffective or unsafe, IVCF plays an important role in mechanical prophylaxis from pulmonary embolism secondary to lower extremity DVT. The role of pIVCFs has been reported in patients with advanced disease and found to safely and effectively prevent VTE. Newer retrievable devices now represent the majority of devices placed today. However, recent data demonstrate that cancer patients with rIVCF have very low retrieval rates; when considering the elevated risk of device-related complications associated with these devices, they may have a limited role in patients with advanced disease. However, patients with early-stage disease, where the risk of VTE is often greatest, may benefit from rIVCF placement, particularly in the periprocedural setting. Accordingly, implantation of an IVCF in cancer patients is best considered on a case-by-case basis with prospective consultation between the interventionalist and requesting physician, and in the case of retrievable filters, diligent follow-up for retrieval once the device is no longer indicated.

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