

STATE-OF-THE-ART PAPER

Inferior Vena Cava Filters

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Venous thromboembolism is common. Most pulmonary emboli arise as thromboses in the deep veins of the lower extremities and may result in serious complications. Inferior vena cava filters (IVCF) are intended to prevent the passage of deep vein thrombosis to the pulmonary arteries. Accepted indications for IVCF placement include the presence of acute venous thromboembolism with inability to administer anticoagulation medication or failure of anticoagulation. Despite these clear indications, IVCF have been commonly placed in patients for primary prevention of pulmonary emboli in patients deemed to be at high risk, along with several other “soft” indications. As a result, IVCF use has been rising over the past 2 decades, especially given the retrievable nature of modern devices. Nonetheless, IVCF are not free of complications, which may occur during implantation and retrieval and while retained in the body. Despite this increase in use, the long-term efficacy remains unclear, and the management of patients with retained filters is often controversial. Finally, filter retrieval in eligible patients is relatively infrequent, suggesting that systems must be in place to improve appropriate filter use and to increase retrieval. (J Am Coll Cardiol Intv 2013;6:539–47) © 2013 by the American College of Cardiology Foundation

Venous thromboembolism (VTE) is common, with a reported incidence of 422 of 100,000 people in the United States (1). Left untreated, pulmonary embolism (PE) will occur in as many as 40% of all proximal deep vein thrombosis (DVT) (2). Whereas first-line treatment for VTE is anticoagulation medication, some patients will experience treatment failure, and anticoagulation is contraindicated in others. Inferior vena cava filters (IVCF), which represent an evolution of earlier techniques, have been gaining popularity (3). A review of trends over 21 years in the U.S. National Discharge Survey (1979 to 1999) and a Medicare survey citing trends between 1999 and 2008, reported a marked increase in the use of

IVCF (4,5). Hospitalization rates for VTE have risen during the same period, although the rate of rise has flattened (1,6), especially when compared with prophylactic (7) and retrievable IVCF (rIVCF) use (8).

Indications for IVCF Implantation

There is significant controversy regarding the appropriate indications for IVCF placement. Recommendations have been suggested as part of several professional medical society consensus documents; however, the body of literature is generally lacking. There are significant differences among these guidelines (Table 1) (9–13). It is noteworthy that whereas the Society for Interventional Radiology’s guidelines delineate more instances in which filter deployment may be considered appropriate, the American College of Chest Physicians’ guidelines are actually less proscriptive, particularly given their recommendation to consider a subjective assessment of bleeding risk as a modifier of several indications (9).

Although all published guidelines agree that IVCF are indicated in patients who have an acute VTE and who cannot receive anticoagulation medications or in whom adequate anticoagulation has clearly failed despite evidence of appropriate use and effect, some indications are more

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controversial. Retrievable inferior vena cava filters (rIVCF) are inserted perioperatively in patients undergoing surgical pulmonary embolectomy with the intent of reducing the effect of post-surgical PE in this unstable population (14). In a retrospective analysis of mortality in 520 patients who were unstable secondary to PE and who underwent embolectomy, all of whom received an IVCF, mortality was lower than in 430 patients who did not receive a filter (25% to 58%, $p < 0.0001$) (15). Furthermore, IVCF placement in patients with poor cardiopulmonary reserve is considered a relative indication by most guidelines (Table 1). The data to support this, however, are poor (9,16). Another relative indication for IVCF in several guidelines are free-floating ilio caval DVT; however, data are conflicting (17,18). Nevertheless, this subset of DVT still appears in the Society for Interventional Radiology guidelines and ACR appropriateness criteria as a relative indication for an IVCF (Table 1).

IVCF have been advocated for patients undergoing pharmacologic and pharmacomechanical thrombolysis of DVT due to the risk of “breakaway” pulmonary embolization (19). In a prospective analysis of 174 patients being treated with streptokinase for DVT via a temporary filter catheter, emboli were detected within the filter in 31.1%, 1 of which was as large as 6.5 cm (20). In an analysis of 17 patients who received rIVCF prior to treatment with catheter-directed thrombolysis or pharmacomechanical thrombolysis for DVT, a trapped thrombus was observed in 8 (47.1%) (19). Conversely, other studies have not shown a clinical benefit of filters during thrombolysis. Filter use and symptomatic PE were very low in a retrospective case-controlled study of catheter-directed thrombolysis in 303 limbs, where PE occurred in 6 patients (21).

IVCF are advocated for high-risk populations without VTE as a prophylactic measure, such as in trauma patients. However, there are several points of controversy regarding this practice. First, deployment-related complications, although uncommon and usually mild, can add morbidity (22). Second, patients will be at risk for long-term complications related to the device if the filter is not removed. Third, the reported incidence of lethal PE in trauma patients varies widely in the literature. In a review of 16 case series concerning trauma patients, PE occurred in 0% to 10% without a filter; however, information regarding patient characteristics and outcomes was limited (23). Fourth, there are alternatives to IVCF for thromboprophylaxis in many of these patients. In a randomized controlled trial of 442 trauma patients randomized to

intermittent pneumatic compression or low-molecular-weight heparin, both treatments seemed effective (24). However, in a meta-analysis pooling data regarding 4,093 subjects in 73 studies that examined reported VTE incidence in trauma patients, the overall incidence for DVT and PE were 11.8% and 1.5%, respectively, and were not shown to be reduced by pharmacological or mechanical prophylaxis (25). Despite these uncertainties, prophylactic IVCF are commonly inserted in trauma patients in some institutions (26–29).

Another patient group that is at high risk for VTE is patients undergoing spine surgery. Over a 6-month follow-up period, 129 patients who underwent spine surgery and received a prophylactic IVCF did not develop VTE, whereas a matched cohort of 193 patients who received only mechanical thromboprophylaxis developed 8 PE over the same period (30). However, in another series in which 74 prophylactic IVCF were inserted, whereas the median time-to-event was not available, 23 patients developed DVT and 1 developed PE after 11 months (31).

IVCF as an alternative to anticoagulation have been suggested in patients with brain tumors and VTE. A retrospective analysis compared survival of 136 patients with brain cancer or intracranial hemorrhage and VTE who were treated with an IVCF and 39 patients who received anticoagulation treatment (32). In an adjusted model, the study showed a decrease in in-hospital mortality (8.8% vs. 12.8%) and an increase in total survival time (21 weeks vs. 11 weeks) in patients who received filters; however, both were not statistically significant, possibly due to lack of sufficient power.

Prophylactic IVCF have been advocated for chronically immobilized patients, although many of them can safely receive anticoagulation or be fitted with intermittent pneumatic devices. In a retrospective imaging-based report of a single-center experience of 371 patients with stroke who received an IVCF, most commonly for contraindications to anticoagulation (68%) and as prophylaxis (22%), PE occurred in 54 (15%) within a median of 3 weeks, DVT in 60 (16%), and symptomatic inferior vena cava (IVC) thrombosis in 5 (1.3%) (33).

Prophylactic IVCF are also being used in patients undergoing elective open gastric bypass surgery. These patients have a 1% to 4% chance of PE despite anticoagulation, most commonly within 1 month of surgery (34,35). Nonetheless, the quality of literature to support this practice is poor. A systematic review of IVCF use in bariatric surgery identified 11 studies, none of which were randomized. Four studies compared an IVCF to a non-IVCF group and 7 were case series (36). Most filters were implanted in high-risk patients; however, the definition for high risk differed between studies and little information was available regarding filter retrieval.

Abbreviations and Acronyms

CI = confidence interval(s)

DVT = deep vein thrombosis

IVC = inferior vena cava

IVCF = inferior vena cava filter(s)

rIVCF = retrievable inferior vena cava filter

PE = pulmonary embolism

VTE = venous thromboembolism

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