Appropriate Use of Inferior Vena Cava Filters

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Expert Analysis

Background

Inferior vena cava filters (IVCF) were developed with the intent of preventing pulmonary embolism (PE) and reducing venous thromboembolism (VTE) related mortality. Nonetheless, IVCF are not devoid of complications. Serious complications such as IVC thrombosis occur in a non-negligible proportion of patients receiving these devices,[1] more so in several high-risk populations such as metastatic cancer patients.[2] Nonetheless, in modern practice these devices are inserted for multiple indications ranging from prophylaxis in high-risk patients to prevention of recurrent VTE in patients who cannot receive anticoagulation due to an acute bleed or need for surgery. Similarly, guidelines for IVCF appropriate use also vary among professional societies (**Table 1**).[3] Interestingly, many indications that are deemed appropriate by radiology guidelines and appropriateness criteria are not mentioned as such by other guidelines. Another testament to the variation in the field are variations in use across countries,[4] states in the United States,[5] and even across counties within states.[6]

Table 1: Potential Indications for Inferior Vena Cava Filter Insertion

Indication*	Societies that Support this Indication	Societies that Oppose this Indication	Comments
Acute VTE and inability to anticoagulate	ACCP,[7] AHA,[8] SIR,[9,10] ACR[11]	-	-
Anticoagulation failure	AHA, SIR, ACR	-	-
Hemodynamically unstable patients, as an adjunct to anticoagulation	ACCP, SIR, AHA, ACR	-	The intent is to prevent further hemodynamic decompensation
Massive PE treated with thrombolysis or thrombectomy or during thrombo-endarterectomy	ACCP, SIR, ACR	AHA	-

Prophylaxis in high-risk populations	SIR, ACR	ACCP	Examples of high-risk populations include multi-trauma and spinal cord injury
Mobile thrombus	SIR, ACR	-	-
Iliocaval DVT	SIR, ACR	-	-

* Indications are not phrased exactly the same in different societal guidelines. The indications as they appear in this table are a result of the authors' interpretation
ACCP – American College of Chest Physicians, AHA – American Heart Association, ACR – American College of Radiology Appropriateness Criteria, DVT – deep vein thrombosis, PE – pulmonary embolism, SIR – Society for Interventional Radiology, VTE – venous thromboembolism

Common Indications for IVCF

Currently there is consensus among guidelines that IVCF are indicated for patients who have suffered an acute venous thromboembolic event (VTE) and who cannot receive anticoagulation.[7-11] IVCF are also commonly suggested for patients who are perceived to have failed anticoagulation.[8-10] In clinical practice, some only suggest IVCF when there is evidence for lower extremity clot, while deferring on their use when only PE are present. This practice is not evidence based. Also, while the term "acute" is not well defined across publications, many practitioners use a 3 month cutoff given the known natural history of deep vein thrombosis (DVT) potential for embolization to pulmonary embolism (PE) and risk of recurrence when anticoagulation is held.[12]

The data supporting any and all indications for IVCF are limited. To date, only two randomized trials have been conducted on IVCF use. The first, PREPIC (Prévention du Risque d'Embolie Pulmonaire par Interruption Cave Study Group), randomized 400 patients who suffered acute VTE to anticoagulation alone or anticoagulation and a permanent IVCF.[13] Follow up was published for 8-year data.[14] This study showed that while IVCF prevented recurrent PE, they did not prevent death, and more DVT occurred in patients who received these devices. The second study, PREPIC 2, utilized retrievable IVCF for a similar comparison.[15] A total of 399 patients with PE associated with DVT were enrolled and randomized to receive anticoagulation only or anticoagulation and a retrievable IVCF. This study enrolled patients who had at least one "high-risk" feature: age >75years old, active cancer, "chronic cardiac or respiratory insufficiency," ischemic stroke with leg paralysis within 6 months, either iliocaval or bilateral DVT, or a sign of right ventricular strain or myocardial injury.[15] Again, IVCF did not show any mortality benefit nor did they result in fewer symptomatic PE during the first 3 months of follow-up. Many of the patients deemed "high-risk" in this publication did not actually exhibit hemodynamic instability and did not have severe RV dysfunction. Thus, the authors used this term in a different manner than that is usually used in clinical practice.

Other Indications for IVCF

IVCF use may be appropriate in patients who are hemodynamically unstable ("to prevent a second hit"). While prospective data are lacking, retrospective and large-database studies have shown benefit for IVCF in this setting. Stein et al. have analyzed data from the National Inpatient Sample and have shown that in patients with massive pulmonary embolism IVCF were associated with reduced mortality.[16] This was true whether thrombolysis was administered or not and across age groups.[17] Importantly, these data are limited as they are both retrospective and limited to discharge codes. Better understanding of the effect of IVCF in this

population would require patient-level data. Also, as noted above, PREPIC 2 attempted to offer information regarding high-risk patients; however, researchers' definition of high-risk was not necessarily the same as that used in clinical practice.

Other indications can only be supported by lower, often anecdotal, quality data. Mobile ("free floating") proximal thrombus and "large clot burden" such as ilio-femoral DVT are such indications with the intent of preventing hemodynamic decompensation from embolization.[18] Two other somewhat similar indications include prevention of embolization during catheter directed treatment of DVT and to prevent intra-operative decompensation for patients undergoing pulmonary thrombo-endarterectomy.[19]

Prophylactic IVCF use is perhaps the most contentious application of these devices. Several patient categories have been advocated for this indication. These include patients undergoing bariatric surgery,[20] multi-trauma patients,[21-23] and patients with spinal cord injury.[24] It is important to note that despite the widespread use of IVCF for prophylaxis, there is a growing body of evidence pointing to lack of benefit and actual harm when IVCF are used for these indications.[25,26] Potential negative outcomes of IVCF could occur during implantation (e.g., hematoma or tilting which may result in reduced IVCF efficacy), while the IVCF is indwelling (e.g., IVCF thrombosis) or at the time of retrieval (e.g., IVC perforation).[1]

Finally, IVCF have been used to prevent PE during catheter directed treatment of DVT. Nonetheless, many believe this practice should be limited as microemboli will not be trapped by the filter and as the lytic agent and anticoagulation used during the procedure will also prevent major adverse embolic events.[27]

IVCF Retrieval

Other than appropriate patient selection, perhaps equally important are appropriate surveillance and retrieval. As noted, published retrieval rates in the United States are disappointing, often as low as 30%.[28] The Food and Drug Administration has issued a statement mandating practitioners to be responsible for IVCF retrieval and prompting timely retrieval.[29]

Furthermore, in the current era of accountability, it is important for both providers and payers to be able to measure appropriate use. While in most prominent centers in the United States this is still performed manually (if at all),[28,30] computerized surveillance systems may show promise. In our institution we have implemented such a system that follows IVCF insertion and retrieval. While not all IVCF are retrieved, some remain permanent purposefully after thoughtful deliberation. Other appropriate reasons for non-retrieval such as patient refusal or patient demise are now being documented.

Conclusions

In conclusion, IVCF are likely being over-utilized. Retrieval rates are low and information regarding appropriate use and surveillance are lacking. Use of these devices should be limited to patients with acute VTE who cannot receive anticoagulation. When IVCF are inserted for other indications this should be after much thought and coupled with appropriate documentation. Implementation of system wide mechanisms to ensure appropriate IVCF use, surveillance and retrieval is crucial in order to prevent important clinically relevant complications.

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Clinical Topics: **Cardiac Surgery, Invasive Cardiovascular Angiography and Intervention, Pulmonary Hypertension and Venous Thromboembolism, Vascular Medicine, Interventions and Vascular Medicine**

Keywords: *Bariatric Surgery, Endarterectomy, Hematoma, Hemodynamics, Neoplasms, Pulmonary Embolism, Radiology, Interventional, Respiratory Insufficiency, Spinal Cord Injuries, Stroke, Thrombectomy, Thrombosis, Vena Cava Filters, Venous Thromboembolism, Venous Thrombosis*