American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Inferior Vena Cava (IVC) Filter Placement**

Variant 1: **Acute pulmonary embolism with negative lower-extremity Doppler ultrasound.**

Treatment/Procedure	Rating	Comments
Anticoagulation	9	
Permanent IVC filter	5	If patient meets accepted criteria for IVC filter. Retrievable filters may be more beneficial in certain populations. See SIR guidelines [14].
Retrievable IVC filter	5	If patient meets accepted criteria for IVC filter. Retrievable filters may be more beneficial in certain populations. See SIR guidelines [14].
Observation/conservative management	1	
Rating Scale: 1=Least appropriate, 9=Most appropriate		

Variant 2: **Acute pulmonary embolism and/or iliofemoral deep-vein thrombosis.**

Treatment/Procedure	Rating	Comments
Anticoagulation	9	
Permanent IVC filter	6	If patient meets accepted criteria for IVC filter. Retrievable filters may be more beneficial in certain populations. See SIR guidelines [14].
Retrievable IVC filter	6	If patient meets accepted criteria for IVC filter. Retrievable filters may be more beneficial in certain populations. See SIR guidelines [14].
Observation/conservative management	1	
Rating Scale: 1=Least appropriate, 9=Most appropriate		

Variant 3: **Symptomatic chronic pulmonary embolism.**

Treatment/Procedure	Rating	Comments
Anticoagulation	9	
Permanent IVC filter	8	
Pulmonary thromboendarterectomy	8	Depends on symptoms and comorbidities. Should be done in institutions with high level of expertise.
Retrievable IVC filter	3	
Observation/conservative management	1	
Rating Scale: 1=Least appropriate, 9=Most appropriate		

Clinical Condition: **Inferior Vena Cava (IVC) Filter Placement**

Variant 4: **Calf deep-vein thrombosis.**

Treatment/Procedure	Rating	Comments
Observation/conservative management	5	No definitive evidence for treatment vs no treatment. Recommend short-term imaging and clinical follow-up.
Anticoagulation	5	If patient at high risk for proximal progression.
Permanent IVC filter	1	
Retrievable IVC filter	1	
Rating Scale: 1=Least appropriate, 9=Most appropriate		

Variant 5: **Prophylactic IVC filter placement in high-risk patient.**

Treatment/Procedure	Rating	Comments
Intermittent pneumatic compression devices	9	
Anticoagulation	9	
Retrievable IVC filter	6	Anticoagulation is still the standard of care. Patient follow-up should be arranged so retrieval can be undertaken when appropriate. Lack of data — further studies needed.
Surveillance US for deep vein thrombosis	5	Cannot be performed in all patients. May be cost prohibitive.
Permanent IVC filter	2	
Observation/conservative management	1	
Rating Scale: 1=Least appropriate, 9=Most appropriate		

Variant 6: **Phelgmasia cerulea dolens undergoing endovascular treatment.**

Treatment/Procedure	Rating	Comments
Anticoagulation	9	
Retrievable IVC filter	5	Existing data are based on permanent filters. Frequently used, but evidence is lacking.
Permanent IVC filter	2	
Observation/conservative management	1	
Rating Scale: 1=Least appropriate, 9=Most appropriate		

Clinical Condition: **Inferior Vena Cava (IVC) Filter Placement**

Variant 7: **Upper-extremity deep-vein thrombosis.**

Treatment/Procedure	Rating	Comments
Anticoagulation	9	
Observation/conservative management	5	Depends on extent of clot and symptoms.
Permanent SVC filter	2	May be useful in high-risk situations. Evidence is lacking.
Retrievable SVC filter	2	May be useful in high-risk situations. Evidence is lacking.
Rating Scale: 1=Least appropriate, 9=Most appropriate		

Variant 8: **Free-floating iliofemoral thrombus.**

Treatment/Procedure	Rating	Comments
Anticoagulation	9	
Endovascular therapy	6	If symptomatic.
Permanent IVC filter	5	Frequently used, but evidence is lacking.
Retrievable IVC filter	5	Frequently used, but evidence is lacking.
Observation/conservative management	1	
Rating Scale: 1=Least appropriate, 9=Most appropriate		

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Summary of Literature Review

Pulmonary embolus (PE) and deep venous thrombosis (DVT) represent the clinical spectrum of venous thromboembolism (VTE), which remains a major cause of morbidity and mortality in hospitalized patients. VTE occurs spontaneously or as a common complication during and after hospitalization for acute medical or surgical illness. PE accounts for 5%-10% of deaths in hospitalized patients and is the most common preventable cause of in-hospital death [1-4]. Recent studies have emphasized that a significant number of medicine and surgery patients are not being given adequate prophylaxis against VTE. More than 50% are at risk of VTE, and only half of them are receiving prophylaxis [5].

The primary prophylaxis and therapy for VTE are pharmacologic, including intravenous (IV) heparin, oral warfarin, or subcutaneous low-dose heparin (LDH) or low-molecular-weight heparin (LMWH) [6]. Lower-extremity graduated compression stockings (GCS) and intermittent pneumatic compression (IPC) devices have been found to be effective as well. Surveillance ultrasound studies in lieu of anticoagulation have also been proposed [7].

Vena cava filters do not prevent nor treat DVT [8,9]. The sole function of inferior vena cava (IVC) filters is prevention of clinically significant and potentially life-threatening PE by preventing the passage of emboli into the pulmonary arterial circulation by trapping the embolus as it passes from the iliofemoral system through the IVC. They are placed percutaneously with relatively low risk to even severely ill patients [10].

Permanent IVC filters have been present for over 35 years, and studies show that the use of IVC filters has dramatically increased in the past 20 years [11,12]. Despite this fact, there is a striking lack of rigorously performed clinical studies. The vast majority of the literature includes retrospective nonrandomized case series. Of 586 studies evaluated in a recent review, two-thirds were retrospective, and the heterogeneous study design of the few large prospective series precludes relevant comparison and analysis [13].

Filters were initially intended in the small group of patients who had VTE and a contraindication to anticoagulation, a complication of anticoagulation, inability to achieve adequate anticoagulation, or recurrent embolus despite anticoagulation [14].

The indications have been expanded by many authors to include a substantial proportion of patients with high VTE risk but no evidence of VTE [15]. The availability of retrievable filter designs extends the clinical utility of filters. Proposed indications now include prophylactic use in patients with major trauma, those who will undergo hip or knee replacement, or patients with compromised cardiopulmonary reserve such as cor pulmonale or pulmonary hypertension, as well as pregnant women with DVT, burn patients, patients undergoing thrombectomy, embolectomy or thrombolysis, and patients with free-floating iliofemoral thrombus [16].

Pulmonary Embolus with a Contraindication to Anticoagulation

There are certain absolute contraindications to anticoagulation in which filters are preferred to prevent PE. These include unsecured intracranial aneurysm after subarachnoid hemorrhage, acute intracerebral hemorrhage, or hematomyelia and current or recent major gastrointestinal hemorrhage or structural lesions at high risk of bleeding (eg, esophageal varices). Relative contraindications include recent (within two weeks) major surgery; major trauma including CPR or deep biopsy; uncontrolled hypertension; renal or hepatic disease; current guaiac-positive stools; and known bleeding diatheses [17]. Neither stable peptic ulcer disease with no history of bleeding nor a history of guaiac-positive stools is a contraindication to anticoagulation. Anticoagulation is safe in most trauma and neurosurgical patients after the first or second postoperative week and in most stroke patients without hemorrhage. Patients with spinal cord injury without hematomyelia may still be considered for anticoagulation [18].

Major Complication of Anticoagulation

Major bleeding is the most significant complication of anticoagulation. It is defined as intracranial or

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retroperitoneal bleeding or bleeding that requires hospitalization or transfusion while on therapeutic levels of heparin. When anticoagulation must be stopped because of major bleeding, placement of an IVC filter should be considered. Heparin-induced thrombocytopenia — defined as platelet count below 50,000/uL, with or without arterial thrombosis — is also considered to be a complication, and placement of an IVC filter should be considered after heparin is discontinued.

Inability to Adequately Anticoagulate

Progression or Recurrence of Venous Thromboembolism despite Adequate Anticoagulation

Although VTE can progress during adequate anticoagulation, it is unusual and therefore it is critical to fully evaluate whether therapeutic levels have been consistently achieved. Raising the target INR (international normalized ratio) is preferable to placing a filter in the setting of inadequate anticoagulation. Hypercoagulable states such as antiphospholipid antibody or Trousseau's syndrome must be excluded prior to filter placement in order to avoid significant morbidity [16].

Patient Factors Affecting Anticoagulation

Elderly patients and patients who are unable to reliably comply with anticoagulation regimen or have a history of falls are at increased risk of hemorrhage and complication, and filters have been used in these patients [17].

Pulmonary Thromboendarterectomy

Patients (3.8% or more) who experience initial symptomatic PE go on to chronic thromboembolic pulmonary hypertension (CTEPH) [19]. Permanent filters are routinely placed in these patients prior to thromboendarterectomy, and these patients are given lifelong anticoagulation as well [20].

Patients with Poor Cardiopulmonary Reserve

Among those at high risk for death or severe morbidity from pulmonary embolism are patients that have severe pulmonary hypertension and a history of PE. There are no data to support the use of prophylactic filters in this setting. When the patient has had multiple prior episodes of VTE and any additional embolization might result in severe morbidity or mortality, a filter may be indicated. Similarly, in the patient who has had cardiovascular collapse as the result of a PE and/or who has undergone pulmonary embolectomy, the use of a filter may be warranted given the potential effects of re-embolization [21].

Free-Floating Iliofemoral Thrombus

There has been much speculation about PE risk due to free-floating iliofemoral thrombus. A prospective study demonstrated no increased risk of PE [22]. No study has demonstrated improved outcomes with IVC filters in addition to or in place of anticoagulation [16].

Prior to Thrombolysis

Catheter-directed thrombolysis appears to result in less PE than systemic thrombolysis for proximal DVT. Filters are sometimes used but have not been shown to be more effective than thrombolysis alone. Retrievable filters may be a viable option in this situation [16].

Cancer Patients

Although cancer has been considered a contraindication to IVC filters in some instances, it is a prothrombotic state and independent risk factor for VTE [23]. Filters have been recommended [24], but pharmacologic approaches such as LMWH are preferred over filters or oral anticoagulation in cancer patients [25].

Pregnancy

Pregnancy is a hypercoagulable state, and VTE complicates 0.5%-1% of pregnancies. Anticoagulation with heparin products is the mainstay of treatment, while warfarin is contraindicated due to teratogenicity. Filters are indicated in selected patients with contraindications to anticoagulation, progression of VTE while anticoagulated, and inability to tolerate a subsequent embolus [26,27].

Patients without Venous Thromboembolic Disease

Prophylaxis in High-Risk Trauma and Spinal Cord Injury Patients

Patients recovering from trauma, especially spinal cord injury patients, have the highest risk of VTE of all hospitalized patients [28,29]. There is great controversy regarding the use of IVC filters in trauma patients, with some authors believing that there is no benefit to filters in trauma patients [7] and that as soon as hemostasis is achieved (within 36 hours in most patients), pharmacologic prophylaxis should begin [30]. Others believe that filters are safe and effective [31].

Prophylaxis in High-Risk Surgery Patients

Patients undergoing orthopedic procedures such as total knee and total hip arthroplasty are at high risk for VTE. Although retrievable filters are sometimes used in the perioperative period, pharmacologic therapies are safe and effective once the immediate risk of hemorrhage is past [32].

Prophylaxis in Burn Patients

Filter use in burn patients was found to be safe in a small series [33] but is not an established indication for filter placement.

Prophylaxis in Bariatric Surgery Patients

PE is a leading cause of perioperative death in bariatric patients due to their many comorbidities. However, there is little evidence to support routine use of filters in place of adequate prophylaxis, such as anticoagulation [34].

Other Clinical Conditions

Patients with COPD, pediatric patients, and organ transplant recipients have also been proposed as potential recipients of IVC filters. However, none of these conditions preclude anticoagulation, and filters are suggested only after the typical indications are met.

Septic Emboli

The proposed use of IVC filters in the case of septic emboli is based on a single animal study and, given the risks of filter infection, is not recommended [35]. Candida

infection of filters has also been reported [36]. Retrievable filters, if they become infected, can be removed.

Filters

Permanent and Retrievable Filter Designs

Permanent and retrievable filter designs are available. There are much more robust data on permanent filter designs, starting with the Greenfield in 1973 and including over 9,500 filter placements. Only 1,000 placements of retrievable designs are described in case series [37]. Six permanent options currently available include the Gianturco Bird's Nest, titanium and stainless steel Greenfield, Simon Nitinol, Vena Tech, and Trap Ease [38,39].

Retrievable designs were originally approved in 2003 and have recommended dwell times from 10-100 days. Three designs available in the U.S. include the Opt Ease, Gunther Tulip, and Recovery, now the G2. Although retrieval is associated with relatively low complication rates [40] in one prospective observational study longer dwell times decreased the rate of successful retrieval from 100% to 50% [41]. Thrombus in a retrievable filter may prevent removal until a period of anticoagulation is possible [42]. The successful removal of retrievable filters requires diligent patient follow-up and interdepartmental cooperation, and even so, successful removal is not always possible [43,44]. The many unanswered questions and further study directions regarding retrievable filters are delineated by Sing et al, including timing of removal, management of trapped thrombus at the time of removal, effectiveness in reducing PE, and whether filter removal prevents caval thrombosis [45].

Superior Vena Cava Filter Placement

Filter placement in the superior vena cava (SVC) is considered for patients with upper-extremity DVT. The decision is complicated by the short length of the available SVC and the associated increased risk of problematic migration or thrombosis [46]. In addition, no filter is specifically designed for the SVC, and such use is considered off-label.

Temporary Inferior Vena Cava Filters

Temporary filter designs in which the filter is anchored externally risk infection and have waned in popularity, given more appealing retrievable alternatives.

Effectiveness

There has been only one randomized clinical trial on caval filters, the PREPIC study [47]. In this study, 400 patients with iliofemoral DVT at high risk for PE were anticoagulated and assigned to either permanent filter or no filter and checked for PE at 2 days and again at 8-12 days by ventilation-perfusion scan. Patients receiving filters had fewer PEs initially and after 2 and 8 years, but over 2 years experienced more frequent DVT and no decrease in mortality. It is important to note that the PREPIC patients were all anticoagulated, while a typical patient receiving an IVC filter has a contraindication to anticoagulation. Therefore, the population of this study is not representative [47,48].

A single large population-based observational study involving nearly 75,000 patients in California showed that in patients with prior VTE, those with filters were readmitted to the hospital for PE as often as those without filters. Among patients who had presented with initial PE, a filter was associated with double the relative risk of DVT. Time to recurrent PE was similar, and among those who had never been hospitalized for VTE, patients with filters had higher mortality — a finding which may represent unidentified comorbidities given the limitations of the observational nature of this study [49].

These studies have placed an emphasis on the retrievable filter concept, in which the embolic risk appears to be highest early on, while the thrombotic complications, including recurrent DVT and caval thrombosis, appear later. This controversy has caused much confusion in the medical community, as many physicians feel that life long anticoagulation may be necessary in any patient with an IVC filter [50]. A 2008 meta-analysis by Ray and Prochazka [51] finds a non-statistically significant trend toward decreased VTE rates in patients undergoing postfilter anticoagulation, suggesting that patients without anticoagulation are not at dramatically increased risk.

Risks and Complications

Filter designs as well as indications continue to evolve. No ideal filter exists [52]. Although filters are effective at reducing the incidence of PE, there is a 3%-5% recurrence rate [53,54]. In a 26-year single-institution study of 1,765 filters, rates of major complication associated with placement were 0.3% and postinsertion migration, fracture, and caval perforation ranged from 0.1%-0.2%. The rate of caval thrombosis was 2.7% (3.2% if the Mobin-Uddin device is included) [11]. Other authors cite a 2%-10% caval thrombosis rate, and up to 30% may thrombose over the long term [38,55]. Another study shows 4%-11% complication rate, with insertion and death in 0.12% [53]. As above, filters appear to increase incidence of recurrent DVT and have not been shown to increase overall survival in the long term [48]. Anticoagulation, with its associated risks, is recommended for patients with permanent filters in place, although this is controversial [50]. Cross-sectional imaging findings of complications such as maldeployment, malpositioning, tilt, migration, perforation, fragmentation, caval thrombosis, and recurrent PE are described by Cina et al [56].

The only definitive indications for vena cava filter placement are as described in the ACCP Conference on Antithrombotic and Thrombolytic Therapy guidelines [57], including the contraindication to, complications from, and failure of anticoagulation. Large, rigorously designed randomized, controlled trials lasting 2 years or more in patients with these indications are required [58]. Anticoagulation should be compared to use of permanent and retrievable filters. Outcomes should include rates of PE and DVT, filter-related complications, mortality, and post-thrombotic syndrome [46].

Summary

- VTE remains an important cause of patient morbidity and mortality. The primary therapy for VTE is pharmacological. In clinical situations where patients with VTE cannot be treated with anticoagulation, IVC filters remain a safe and effective method to prevent fatal PE. The clinical application of IVC filters has greatly expanded in the past 20 years. Despite this fact, the limited number of prospective randomized trials of IVC filter patient populations is recognized as a problem when making recommendations about the clinical use of IVC filters. Patients with absolute indications, such as those with VTE and contraindication or complication of anticoagulation, have the highest consensus use for IVC filters. Patients with relative indications for IVC filter insertion may have lower consensus ratings, while prophylactic use of filters such as in trauma populations is still a debated and controversial subject with wide practice variation.
- For the present, the indications for use of permanent and retrievable IVC filters remain unchanged. Future studies may point out subpopulations of patients with specific clinical indications that may warrant use of retrievable IVC filters. Present use of retrievable filters is limited in many instances by the small number of filters that are actually removed.
- Symptomatic chronic PE patients should be treated with pharmacological methods and IVC filtration and referred to specialized centers to determine whether pulmonary thromboendarterectomy is appropriate for them.
- SVC filter use continues to increase but is currently considered off-label use as no current-generation IVC filters are specifically designed or approved for this location.
- While IVC filter complication rates are low, severe complications do occasionally occur. Future research should better define the risk/benefit ratio of IVC filtration for various patient populations.

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Evidence Table

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