Inferior Vena Cava Filters: Placement and Retrieval

■ Benjamin J. Shin, MD; Jeffrey Forris Beecham Chick, MD, MPH; and S. William Stavropoulos, MD

ABSTRACT: **The incidence of venous thromboembolism, including both deep venous thrombosis and pulmonary embolism, is approximately 100 per 100,000 patients in the United States. Although anticoagulation is the mainstay of treatment, increasing numbers of patients with absolute contraindications, treatment failures, and complications has led to rising numbers of inferior vena cava (IVC) filter placements. IVC filter placements, however, are not without potential early and long-term complications such as filter thrombosis, perforation, migration, fracture, and embolization. Although IVC filter removal is successful in many cases, retrieval may be technically challenging, and ultimately unsuccessful, due to associated thrombus, substantial filter tilting, filter fracture, and excessive tissue embedding surrounding the tip or struts. As a result of increasing prevalence of IVC filters, it is important that all members of the health care team be comfortable with these devices. The purpose of this article is to provide a comprehensive review of IVC filters, their placement, and retrieval. (J Radiol Nurs 2015;34:228-236.)**

KEYWORDS: **Inferior vena cava filter; IVC filter; Filter placement; Filter retrieval; Pulmonary embolism.**

INTRODUCTION

Pulmonary embolism (PE) continues to be a cause of significant morbidity and mortality. It is the third leading cardiovascular cause of death, with an estimated 3-month mortality rate ranging from 15% to 18% (Goldhaber & Bounameaux, 2012; Tapson, 2008). If not adequately treated, PE may result in chronic pulmonary hypertension and cor pulmonale (right heart strain) (Pengo et al., 2004; Dalen & Alpert, 1975; Hackel et al., 1993). A significant source of PE is the deep venous circulation where thromboembolic events may occur within a hypercoagulable milieu of inflammation and stasis (Goldhaber & Bounameaux, 2012). Therefore, once diagnosed with a deep vein thrombosis (DVT), prompt treatment with anticoagulation is paramount to prevent dire complications such as PE and the post-thrombotic state (pain, heaviness, leg swelling, and ulceration). Treatment regimens include low-molecular-weight heparin or intravenous heparin followed by oral anticoagulants such as vitamin K antagonists (Burgazli et al., 2013; Prandoni et al., 1992). However, in instances where anticoagulation is contraindicated or shown to be ineffective, inferior vena cava (IVC) filters may be used to prevent PE.

An IVC filter is a metallic filter placed endovascularly into the IVC to prevent lower extremity blood clots from embolizing into the pulmonary arterial circulation. Blood clots that are sequestered in the IVC filter are then dissolved by the body's own natural thrombolytic mechanisms. The implantable IVC filter was first introduced by Mobin-Uddin in 1969 and Greenfield in 1973, and the use of IVC filters has grown tremendously since the 1990s (Sarosiek et al., 2013; Becker et al., 1992; Stein et al., 2004). Permanent IVC filters are those that stay in place and are not removed. Retrievable IVC filters are those that may be removed

Benjamin J. Shin, MD, Resident in Radiology, Division of Interventional Radiology, Department of Radiology, University of Pennsylvania Health System, Philadelphia, PA; Jeffrey Forris Beecham Chick, MD, MPH, Constantin Cope Cook Endowed Fellow in Interventional Radiology, Division of Interventional Radiology, Department of Radiology, University of Pennsylvania Health System, Philadelphia, PA; S. William Stavropoulos, MD, Professor of Radiology, Vice Chair for Clinical Operations, Division of Interventional Radiology, Department of Radiology, University of Pennsylvania Health System, Philadelphia, PA.

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Corresponding author: S. William Stavropoulos, Department of Radiology, Division of Interventional Radiology, University of Pennsylvania Health System, 1 Silverstein, 3400 Spruce Street, Philadelphia, PA 19104. E-mail: S.Stavropoulos@uphs.upenn.edu

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percutaneously or may be left in place permanently. A retrievable IVC filter is removed by capturing the hook on the IVC filter tip with a snare and removing the filter through a sheath. The radiopaque hook may often be identified on plain radiographs to determine whether the IVC filter is the type that may be retrievable (Figure 1) or must be left in place. Other integral components of an IVC filter include the tip and the arms (shorter struts) and legs (longer struts). The tip filter should always point in the direction of blood flow toward the heart so that clots may be captured within the filter legs.

Because of the ease of placement, there has been a tremendous increase in filter use especially after the Food and Drug Administration (FDA) approval of retrievable IVC filters in the early 2000s. Between 1999 and 2008, the number of IVC filters placed nearly doubled according to Medicare claims data (Duszak Jr. et al., 2011). As of a result of increasing widespread use of IVC filters, it is important that all members of the medical fields, including ancillary staff, nurses, technologists, and physicians, be comfortable with IVC filters to improve communication with patients and to provide better care. The purpose of this article is to provide a comprehensive review of IVC filters and offer a case study that is applicable to most clinical situations where IVC filters are used.

INDICATIONS

The most common indication for placing an IVC filter is to prevent PE in patients with deep vein thrombosis (DVT) who cannot be anticoagulated. Pharmacological intervention is otherwise the first-line treatment for DVT. Two societies, the American College of Chest Physicians and Society of Interventional Radiology, have formally released guidelines to provide recommendations on when to insert an IVC filter (Kaufman et al., 2006b; Baadh et al., 2012; Hirsh et al., 2008). According to the Society of Interventional Radiology guidelines, an absolute indication is in patients with documented venous thromboembolism (VTE), who are at high risk for PE, and in whom anticoagulation is contraindicated, ineffective, or associated with a complication (Kaufman et al., 2006a). Relative indications for IVC filter placement include iliocaval (involving the IVC and iliac vessels) DVT, free-floating proximal DVT (widowmaker thrombus), massive PE, VTE with limited cardiac reserve, VTE with high risk for anticoagulation complication such as frequent falls or poor anticoagulation compliance/difficulty achieving anticoagulation (Kaufman et al., 2006a). The American College of Chest Physicians adds the recommendation that patients with IVC filters for DVTs as initial treatment eventually be anticoagulated once no longer at a high risk for bleeding or complication (Hirsh et al., 2008). Strong contraindications include no venous access to the IVC, no location available in the IVC filter placement, complete IVC thrombosis, and uncorrectable coagulopathy.

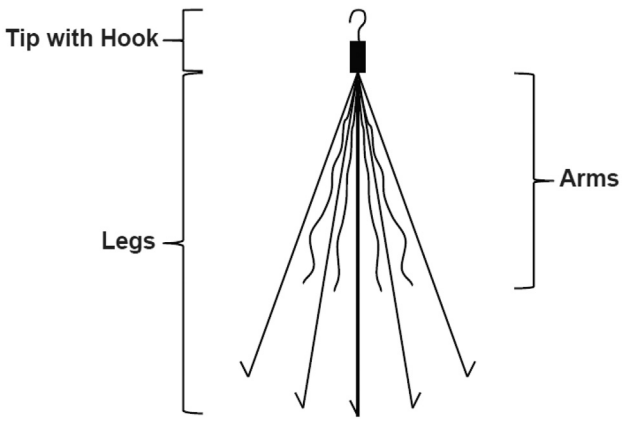

Figure 1. Components of some inferior vena cava filter include the tip with a hook, arms (short struts), and legs (long struts). The hook may be snared from above to allow for percutaneous retrieval. The arms center the filter to prevent tip embedment within the inferior vena cava wall and optimal inferior vena cava coverage. The legs capture clot to prevent further embolization to the heart and pulmonary arteries.

There are other indications, not yet as well established by randomized trials, for IVC filter placement for high-risk patients without DVTs including traumatic or surgical circumstances, therefore considered prophylactic. At our institution and elsewhere, IVC filters are commonly placed in morbidly obese patients who are about to undergo bariatric surgery (Rowland et al., 2015; Kaw et al., 2014). These patients are at particularly high risk for DVT because of body habitus and immobility (Abdollahi et al., 2003; Ageno et al., 2008; Goldhaber et al., 1997). In addition, weight-based prophylactic anticoagulation may be challenging for these patients (Patel et al., 2011). Using a similar rational, IVC filters are often placed in those who will be immobilized for long periods after an invasive surgical procedure such as spinal surgery, which would preclude therapeutic anticoagulation should a DVT occur (McClendon Jr. et al., 2012). Finally, prophylactic IVC filters are sometimes placed for trauma patients with anticipated long periods of immobility (Haut et al., 2014; McMurtry et al., 1999; Kidane et al., 2012). These patients are at high risk for both bleeding after anticoagulation as well as DVT and PE (Hill et al., 1994; Mackiewicz-Milewska et al., 2015; Kudsk et al., 1989). Whether in anticipation of major surgery or in the trauma setting, retrievable IVC filters allow for