Endovascular Removal of an IVC Filter via the Azygos Vein

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Abstract

Inferior vena cava (IVC) filter placement is a routine procedure for preventing pulmonary emboli in patients in whom anticoagulation is problematic. With the advent of retrievable (optional) IVC filters and the recognition of various potential complications related to long-term indwelling, malpositioned or compromised/fractured filters, an aggressive approach to filter removal is often justified. Despite a high rate of technical success, the retrieval procedure is sometimes complicated and may require advanced techniques for device removal. In this report, we describe a novel technique for removal of an improperly placed retrievable IVC filter via the azygos vein.

Keywords: IVC Filter; Option; Filter Retrieval

Introduction

Venous thromboembolism (VTE) is the third most common cardiovascular illness after acute coronary syndrome and stroke, with an approximate incidence of 1 million cases annually [1]. Further, VTE is the third most common cause of hospital-related mortality in the United States and the most common cause of preventable in-hospital mortality [2]. VTE may be attributed to etiologic factors including damage to the endothelial lining of blood vessels, stasis of blood flow, and hypercoagulability of blood and may manifest as deep vein thrombosis (DVT) and the more fatal pulmonary embolism (PE); of the estimated 900,000 Americans who develop DVT each year, 500,000 develop PE, which has a 30% mortality rate [2].

Clinical intervention for VTE prophylaxis may be pharmacologic (anticoagulation), or mechanical (inferior vena cava [IVC] filter placement). Contraindications for the placement of IVC filters have expanded over the years, and include contraindication to anticoagulation, complications of anticoagulation, recurrent thromboembolism despite adequate anticoagulant therapy, and patients undergoing pulmonary embolotomy [3].

Mortality from filter placement is quite low; three deaths (0.12 percent) were reported in a review of 2557 patients undergoing filter insertion [4], but there are well-recognized complications that are associated with indwelling IVC filters that include filter migration, filter fracture, penetration of the IVC wall, IVC thrombosis/occlusion, and DVT at the site of insertion, among others. Newer “retrievable” or “optional” filters can be placed and then removed at a later date, if indicated, representing a technological advance as compared to permanent filters. Retrieval of such IVC filters is a routine procedure for the prevention of complications relating to prolonged filter presence or improper filter placement; however removal of an IVC filter through the azygos vein has never been reported in the literature. In this report, we describe a technique that was used to remove a malpositioned optional IVC filter via the azygos vein.

Case Report

A 55 year old man with a history of antithrombin III deficiency presented to an outside hospital with significant left lower extremity swelling, erythema, and pain and was diagnosed by ultrasound to have extensive DVT extending from the popliteal to the common femoral vein. He was started on a Lovenox bridge to Coumadin and was discharged home.

Because of continued worsening left lower extremity pain and swelling, the patient subsequently underwent left
lower extremity venography, catheter-directed thrombolysis and IVC filter placement one week later. He tolerated the procedure well and experienced significant clinical improvement. However, during filter placement the device, an Option™ IVC filter (Argon Medical Devices Inc., Athens, TX) was unintentionally malpositioned in the IVC so that the filter apex was tilted into the azygos vein (Figure 1). An attempt to remove the filter at the outside hospital was unsuccessful and the patient was thus referred to our institution for filter retrieval.

The patient was brought to the angiography suite, the right internal jugular vein was accessed under sonographic guidance and a 5F vascular sheath was inserted. A pigtail catheter was advanced into the right common iliac vein, and inferior vena cavaography was performed. The flush catheter was removed and a 5F Kumpe catheter and 0.035-in hydrophilic guidewire were used to cannulate the azygos vein at its confluence with the superior vena cava (SVC). Contrast injection demonstrated that the cephalad portion of the azygos vein was patent and the caudal portion that connected to the IVC was tapered and then occluded. The right common femoral vein was then accessed and a 5F vascular sheath was placed. A Kumpe catheter was introduced into the IVC and multiple unsuccessful attempts were made to advance the catheter through the base of the filter and into the venous side branch in which the filter apex was located. The Kumpe catheter was removed and the right common femoral venous 5 Fr sheath was replaced with an 8Fr sheath.

As it was apparent that the filter position and orientation precluded a standard retrieval approach via either the SVC or IVC, the Kumpe catheter within the azygos vein was advanced caudally and was used to direct a hydrophilic guidewire alongside the filter and into the IVC. An EN Snare® device (Merit Medical Systems Inc., South Jordan, UT) was then introduced via the 8 Fr right femoral sheath and was used to snare the guidewire and withdraw the tip through the right groin access. A 5F glide catheter was then advanced from the jugular vein access over the snared guidewire which was replaced with an exchange length stiff guidewire. Via the right jugular access, a 12 French vascular sheath was introduced over the guidewire into the azygos vein and multiple unsuccessful attempts were made to snare the hook at the filter apex using a standard IVC retrieval kit and various snare configurations.

A 50cm long 14 Fr vascular access sheath was then introduced over the guidewire via the jugular vein access and was advanced into the caudal azygos vein and positioned immediately proximal to the filter apex. A rigid endobronchial forceps was introduced via the sheath and was used to grasp the apex and upper body of the filter, which were successfully pulled into the sheath. Despite this, the filter could not be completely dislodged using the endobronchial forceps and thus a goose neck snare was advanced through the sheath and was used to successfully engage the IVC filter hook within the sheath (Figure 2). The IVC filter was then removed through the sheath and was determined to be intact.

Figure 1.
Venography of the inferior vena cava (IVC) demonstrates the Option filter apex tilted into the azygos vein.

(A) Apex and upper body of the inferior vena cava (IVC) filter are captured using rigid endobronchial forceps introduced via a 14 Fr sheath positioned in the azygos vein. (B) Goose neck snare used to capture the IVC filter hook and filter is subsequently pulled into the sheath.

Repeat inferior vena cavaography via a pigtail flush catheter introduced from the right femoral sheath was
performed. This demonstrated a small focal filling defect in the medial wall of the IVC where the filter was tilted into the azygos vein, but an otherwise intact IVC with no extravasation (Figure 3). Pullback azygos venography demonstrated a persistently occluded distal segment with a patent more proximal segment.

Figure 3.
Inferior venacavagram after filter retrieval shows a small focal filling defect in the medial wall of the IVC where the filter was tilted into the azygos vein. The IVC is otherwise unremarkable.

Discussion

Although DVT is not in itself life threatening, PE is a major health problem that represents the third most common cause of death in hospitalized patients; massive PE causes as many as 300,000 deaths annually in the United States [5]. For patients in whom DVT prophylaxis with anticoagulation is problematic, IVC filter placement is an alternative. Although the indications for IVC filter placement have been expanded over the years, the presence of DVT or PE in a patient in whom anticoagulation therapy is contraindicated remains the most frequent indication, accounting for 38-77% of patients undergoing IVC filter placement [6]. A systematic review of IVC filters estimated the incidence of pulmonary embolism following filter placement of 1.3 percent [7].

Since their initial introduction, IVC filters have undergone multiple design iterations, with newer devices engineered to optimize hemodynamics, maximize mechanical trapping capacity, expedite ease of insertion and permit eventual removal. Until relatively recently, IVC filters were available only as permanently implanted devices. Newer "optional" or "retrievable" filters can be removed after the risk of pulmonary emboli has passed or once anticoagulation can be instituted or resumed. Furthermore, IVC filter retrieval eliminates any of the various well-known complications that can occur as a result of a prolonged filter presence.

Filter retrieval is achieved in >90 percent of attempts [8], but despite a high rate of technical success, a large number of patients do not undergo filter retrieval. In one review at a large trauma center, an attempt to remove a previously placed retrievable filter was made in only 10.3 percent of the patients [9]. As a result of such reports, the United States Food and Drug Administration (FDA) has recommended that "implanting physicians and clinicians responsible for the ongoing care of patients with retrievable IVC filters consider removing the filter as soon as protection is no longer needed" [10].

Along with the potential complications that may occur with a prolonged filter presence, improperly placed or malpositioned IVC filters (permanent or retrievable) put the patient at even greater risk for filter-related complications and should be retrieved when possible. Removal of malpositioned filters can be technically challenging and potentially unsuccessful and is generally either due to adherence of filter components to the vessel wall as a result of venous endothelialization, or the inability to grasp the proximal hook of the filter because of the orientation of the device within the vessel. Although most currently available filters are retrieved via an internal jugular vein approach, to our knowledge IVC filter retrieval via the azygos vein has not been previously reported.

References


