Bedside Placement of IVC Filters

This new IVUS-directed technique of filter placement significantly reduces risk in some patients.

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The incidence of pulmonary embolism (PE) has been reported in approximately 355,000 patients per year, with an estimated annual mortality rate of 240,000.[1] The search for safe and effective means of preventing or reducing PE in postoperative and critically ill patients led to the invention of devices for vena cava interruption and filtration. Prophylactic vena cava filter placement offers a protection rate of almost 99% against fatal PE.[2-4] Vena cava filters are most strongly indicated for patients with PE who have contraindications for anticoagulation. For these specific patients, a 4% incidence of recurrent PE has been reported after vena cava filter placement.[5]

INDICATIONS FOR FILTER PLACEMENT

Anticoagulation, if tolerated, is the first-line therapy for patients with acute deep venous thrombosis (DVT) and PE. The following are frequent indications for vena cava filter placement:

(1) Documented DVT or PE with a contraindication to anticoagulation: Hemorrhage or recent or impending major surgery frequently are contraindications to anticoagulant administration. Patients with central nervous system or intracranial hemorrhage, massive hemoptysis, gross gastrointestinal bleeding, or retroperitoneal hemorrhage are typical examples of contraindications for anticoagulation.

(2) PE despite therapeutic anticoagulation.

(3) Prophylaxis for proximal free-floating thrombus: A 60% incidence of PE has been reported when free-floating thrombus in an iliofemoral vein exist, even in the

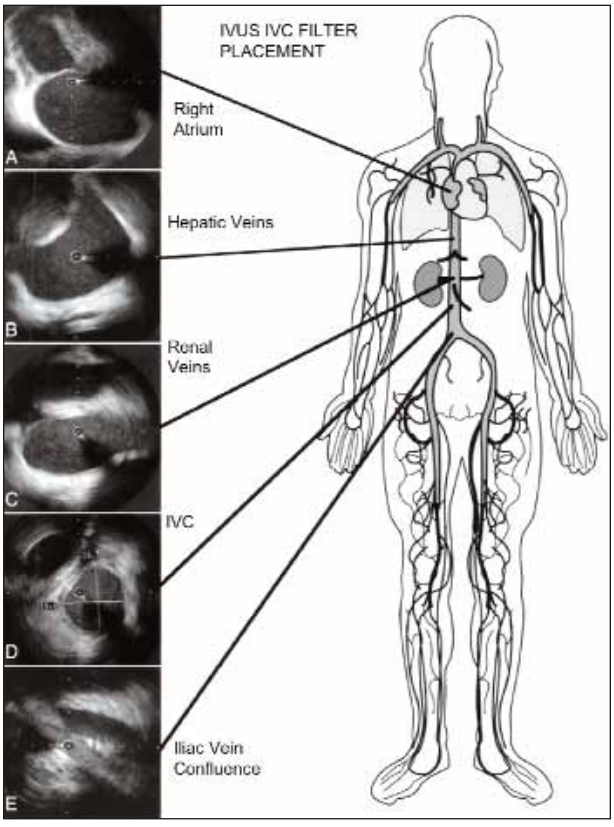

Figure 1. Pullback technique illustrating the various anatomic structures of interest. Right atrium (A). Hepatic veins (B). Renal veins (C). Infrarenal vena cava (D). Iliac vein confluence (E). (Reprinted with permission from Alliance Communications Group, J Endovasc Surg 1999;6:285-287).

presence of therapeutic anticoagulation.[6] Iliofemoral thrombosis with a 5 cm or longer free-floating tail may have a higher risk of emboli and could undergo prophylactic vena cava filter placement through a pathway that avoids the involved vessel for filter placement.[7] However, this indication is not universally accepted, and many experts do not recommend filters for these patients.

(4) High-risk patient populations: Patients with preexisting pulmonary hypertension and reduced cardiac reserve who are undergoing surgery for morbid obesity or prolonged spinal procedures have been considered for this category. Near-fatal PE is sometimes an indication for filter placement.

Because of the increased incidence of PE in trauma patients, the use of prophylactic filter placement in this patient population has been considered.[8] Many experts recommend chemoprophylaxis and mechanical compression for trauma patients who have sustained severe head injury, spinal cord trauma, multiple long-bone fractures, pelvic fracture, or direct venous trauma. One single-institution study found that prophylactic vena cava filters offered a 99.5% protection rate, with only one of 187 patients having a nonfatal PE.[2]

BEDSIDE FILTER PLACEMENT TECHNIQUES

Vena cava filters have been placed at the bedside because of increased patient safety, convenience, and cost savings. By removing the risk of patient transport, this technique appears particularly useful for critically ill patients who require ongoing intensive care. Portable fluoroscopy, duplex ultrasound, and intravascular ultrasound (IVUS; Boston Scientific Corporation, Natick, MA) have all been used to assist with bedside filter placement.[9,10]

At Northwestern University, we developed a technique for inferior vena cava (IVC) filter insertion using IVUS guidance. In our protocol, patients underwent lower-extremity, venous duplex imaging to examine the common femoral and external iliac veins on the side of the proposed insertion to ensure that no thrombus would be encountered in the passage of the IVUS probe and during filter deployment. After appropriate preparation and draping of the groin, we performed "premeasurement" of the monorail-configuration IVUS catheter to the precise length of the over-the-wire percutaneous femoral Greenfield deployment device (Boston Scientific Corporation). Premeasurement allows placement of external markers during IVUS pullback assessment, which will directly correlate with the subsequent IVC filter deployment device length and position.

After access to the femoral vein is achieved, a J-tipped guidewire is passed into the central venous circulation and exchanged for a floppy-tipped, super-stiff wire. The IVUS catheter is passed over the super-stiff wire to the level of the right atrium. Venous anatomy is documented during pullback (Figure 1), and the landing zone between the renal veins and iliac vein confluence is marked on the immobilized external sterile drape. The right renal artery is a key landmark for placement of the apex of the filter. This is confirmed with a second pullback run. The 8-F sheath is removed and the deployment sheath is inserted after serially dilating the tract. The vena cava filter is then deployed in the cephalad end of the landing zone after removal of the guidewire. The guidewire is removed before deployment to avoid entrapment of the wire in the limbs of the filter. After deployment, an abdominal x-ray is obtained to assess filter location, tilt, and limb deployment.

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A study done by Conners et al examined the efficacy of duplex ultrasound-directed IVC filter placement, and found it to be safe, cost-effective, and convenient for patients who require IVC filters.[11] Both IVUS and transabdominal ultrasound methods avoid radiation exposure, use of nephrotoxic intravenous contrast, and transportation from an intensive care unit to the operating room or angiography suite.[9,11]

Vena cava visualization using duplex ultrasound can be limited by a patient's body habitus, overlying abdominal wounds, bowel distention, and abdominal packing. IVUS can overcome these limitations. A 92% successful placement rate has been achieved in previous studies and the procedure can take less than 15 minutes after obtaining venous access. In the last 5 years, we have placed more than 50 Greenfield filters by an IVUS-directed technique. Compared to duplex ultrasound and fluoroscopy, IVUS requires a single operator, and caval visualization is not hindered by obesity, open abdominal wounds, bowel gas, and abdominal packing. Immediate confirmation of filter placement with a portable abdominal radiograph showed only one patient to have had filter tilt greater than 13º, and there was no significant limb asymmetry. One filter was placed in the common iliac vein before the current premeasurement technique was adopted. In follow-up, there was one episode of insertion site thrombosis that

resolved after 29 days, and one filter thrombosis that resolved after 5 months of anticoagulation. No clinical pulmonary emboli have occurred. It is also cost-effective compared to the angiography suite and operating room.[12]

CONCLUSION

Vena cava filters can be effective in reducing the mortality rates associated with PE, particularly for patients who cannot be treated with anticoagulation. New techniques are available for bedside placement of filters that eliminate the risk of transporting critically ill patients. We have found IVUS is our preferred imaging technique to guide bedside filter placement and is safe and cost-effective. ■

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There has been a change in the indications for inferior vena cava (IVC) filter placement. In the earliest reports of filter use, the majority of filters were placed because of the failure of anticoagulation to prevent pulmonary embolism (PE).[1] Now, more than half of filters are placed prophylactically for the prevention of PE.[2] Not only are filters being placed for prophylaxis against PE in patients with known deep vein thrombosis (DVT), but filters are also being used in patients who are only at risk of developing a thromboembolic event.

There are three main conditions for which filters are being placed prophylactically for this indication. Neurosurgical patients, especially those with paralysis, are at particularly high risk for PE and are often not able to be anticoagulated because of the risk of intracranial hemorrhage. Second, many trauma centers have adopted policies of prophylactic IVC filter placement in high-risk patients, such as those who are immobile, or are at risk for bleeding complications, or are unable to be screened with ultrasound for DVT due to their injuries. Langan et al have shown a significantly reduced incidence of PE in those high-risk trauma patients who have undergone prophylactic filter placement.[3] Last, obese patients undergoing surgery are at substantial risk for developing thromboembolic disease. The increasingly important role of surgical therapy for treating the morbidly obese has brought more relevance to the issue of prophylaxis for PE in this patient population. The introduction of retrievable IVC filters may perpetuate the increased use of filters for prophylaxis. This is particularly true in patients with a short, defined period of increased risk for thromboembolic disease.

INDICATIONS FOR PLACEMENT OF IVC FILTERS IN BARIATRIC SURGERY PATIENTS

Routine use of some form of prophylaxis for DVT after surgery for morbid obesity is used by nearly all surgeons.[4] However, there is little consensus in the method used for prophylaxis. Despite aggressive use of perioperative intermittent compression stockings, early ambulation, and anticoagulation, there is still a significant incidence of PE (approximately 1% overall and up to 4% in high-risk patients).[4,5] After a review of their vast experience with obesity surgery, Sapala et al were able to identify four comorbid factors associated with the development of PE.[6] These factors include severe venous stasis disease, a body mass index (BMI) of greater than 60, truncal obesity, and obesity hypoventilation syndrome/sleep apnea. In addition, other risk factors include a documented history of DVT/PE, a hypercoagulable state (Table 1), strong family history of DVT, use of oral contraceptives, age >60 years, and expected