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CURRENT USE OF VENA CAVAL FILTERS

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Aim: ***The use of vena caval filters has increased significantly since the introduction of percutaneous placement techniques and the development of reduced-profile devices. This study was conducted to evaluate our current use of vena caval filters.***
Patients and methods: ***Between January 2000 and May 2004, fifty- five patients (26 males) underwent vena cava filter placement. The indications for filter placement were contraindication or failure of anticoagulation in 51 patients and prophylaxis in 4 (7.2%) patients. Titanium Greenfield filters were inserted in 33 patients (60%), VenaTech filters in 15 patients (27.2%), Simon Nitinol filter in one patient (1.8%), Bird's Nest filters in three patients (5.4%), and TrapEase filters in three patients (5.4%).***
Results: ***All attempts at filter placement were successful. The deployment sites were the infra-renal inferior vena cava (IVC) in 52 patients, the supra-renal IVC in two patients, and the superior vena cava (SVC) in one patient. No procedure-related mortality occurred in this study population. Three patients developed caval thrombosis (5.4%). Three more patients (5.4%) had recurrent deep venous thrombosis (DVT) and another patient had recurrent pulmonary embolism (PE). Comparison with studies published showed that our current indications and results are in agreement with others.***
Conclusion: ***This study demonstrated that caval filter placement continues to be an effective and safe adjunct in the treatment of venous thromboembolic disease and a satisfactory prophylactic measure in specific high-risk patients.***

Keywords*: Deep venous thrombosis, pulmonary embolism, vena cava filters, anticoagulation.*

INTRODUCTION

Anticoagulant therapy is the standard approach to the management of venous thromboembolism. If there are contraindications to anticoagulation, other methods may be considered to prevent the passage of large, life-threatening emboli to the lungs. Surgical ligation, plication or clipping of the IVC were methods of choice until the early 1970s.[1-4] The morbidity of surgical caval interruption, however, was substantial.[5]

The development of transvenous approaches under local anesthesia was the next logical step. The earliest transvenous approaches demonstrated the ease of access to the vena cava under local anesthesia and fluoroscopy, however, it was found to have a high rate of subsequent vena caval thrombosis and was associated with proximal thrombus formation and occasional device migration.[5,6] A new generation of devices was developed to facilitate placement, reliable capture of thromboemboli, and long-term caval patency. Consequently, the improved IVC filters have led to liberalization of the indications for insertion.[1,7,8]

Caval filters are now inserted in the suprarenal IVC,[9,10] in the SVC for upper extremity DVT,[11-13] as a prophylactic measure in high risk surgical,[14] or trauma patients,[15-20] at the bed-side using duplex scanning,[21] or intravascular ultrasound instead of fluoroscopy[22-25] and in cancer,[26, 27] septic[28] and pediatric patient population.[29, 30] Recently, temporary filters (must be removed)[19, 31-34] or retrievable filters (may be removed)[15, 35-38] have been placed during the period of increased risk for venous thromboembolism.

The purpose of this study was to evaluate our current indications and results of vena caval filter placement.

PATIENTS AND METHODS

Between January 2000 and May 2004, 55 patients

underwent vena caval filter placement to prevent pulmonary embolism. Patients suspected of having DVT were subjected to duplex ultrasound scanning examination to confirm the diagnosis and define the anatomical extent of the disease.

Criteria for successful placement of filters as described by the Vena Caval Filter Consensus Conference were used to record our filter placement results.[39] Technical success was defined as proper placement of the filter, while failure occurs when the filter cannot be placed as intended and a second attempt is made with a different filter.[39] Procedural complications include insertion site thrombosis or hemorrhage, infection or the development of an arteriovenous fistula, or positioning that requires placing an additional filter or correcting the placement of an existing filter were documented. Post-deployment assessment of the stability of the filter was documented by means of orthogonal plain films and cavography when necessary.

Follow-up included history and clinical examination including venous duplex scanning for recurrent DVT or caval thrombosis. Caval patency was determined by direct visualization of the IVC and the presence of spontaneous, phasic Doppler signals and the augmentation of flow after a Valsalva maneuver. Any patient in whom signs and symptoms of PE developed underwent a ventilation-perfusion (V/Q) lung scan. Follow-up ranged between 2 and 54 months.

RESULTS

Our patient population comprised of 26 males and 29 females with a mean age of 47 years and a rage of 24 to 71 years. Indications for filter insertion Table 1 were extension or new DVT or PE in spite of adequate anticoagulation in 22 patients, contraindication to anticoagulation in 16 patients, complication of anticoagulation in 13 patients, free floating thrombus in two patients, and prophylactic before venous thrombectomy in one patient and in severe pelvic and lower extremity multiple trauma in one patient (Fig. 1). Underlying disease at the time of insertion of filter was cancer in nine patients, postoperative in 13 patients, antiphospholipid syndrome in one patient, multiple trauma in one patient and no underlying cause for thromboembolism in 31 patients. The anatomical extent of DVT as defined by duplex ultrasound examination was iliofemoral in 38 patients, femoropopliteal in 13 patients,

caval in two patients, and upper extremity DVT in one patient. Pre-insertion venography was performed in 8 patients when duplex examination was not conclusive regarding the proximal extent of the thrombus. Pulmonary embolism was suspected on clinical grounds in 21 patients. Ventilation perfusion (V/Q) lung scan performed in 18 patients demonstrated moderate to high probability of PE in 16 patients and was inconclusive in two patients.

Filter insertion was performed in the operating room under fluoroscopic mobile unite (C-arm) in 46 patients and in the radiology suite in nine patients. Local anesthesia was used in all patients. All attempts at filter placement were successful i.e. 100% technical success. Types of filters used were Titanium Greenfield filters (Medi-Tech, Boston Scientific Corporation, Watertown, Mass., USA) in 33 patients (60%), Vena Tech VCF filters (B/Braun/VenaTech, Evanston, Ill, USA) in 15 patients (27.2%), Simon Nitinol filter (Bard Radiology, Covington, GA, USA) in one patient (1.8%), Bird's Nest filters (Cook, Inc, Bloomington, Ind., USA) in three patients (5.4%), TrapEase filters (Cordis/Johnson & Johnson Gateway, Piscataway, New Jersey, USA) in three (5.4%) patients (Fig. 2). The access site was the right internal jugular vein in 41 patients and the right common femoral vein in 14 patients. The deployment sites were the infra-renal IVC in 52 patients, the supra-renal IVC in two patients, and the SVC in one patient. Postoperatively patients continued to receive anticoagulation if not contraindicated.

Procedure-related complications occurred in four (7%) patients. One patient had tilting of the filter, two patients had incomplete opening, and one patient had one of the struts of Bird's nest filter encroaching on the right renal vein. None of these complication resulted in recurrent PE, caval thrombosis or renal dysfunction.

There was no procedure-related mortality in this study population. During follow-up (range, 2 to 54 months) five patients with malignancy died between two weeks and one year after filter insertion as a result of their malignant disease. Three patients developed caval thrombosis (5.4%) of whom one patient had recanalization as demonstrated by duplex examination six months later. Three more patients (5.4%) had recurrent DVT and another patient (1.8%) had recurrent PE.

Table 1. Indications for filter placement

Indication	Number (%)
Contraindication to anticoagulation	16 (29.1)
Failure of anticoagulation	22 (40)
Complications of anticoagulation	13 (23.6)
Prophylaxis	4 (7.3%)
Free floating thrombus	2 (3.6)

Before venous thrombectomy	1 (1.8)
High-risk trauma	1 (1.8)

Table 2. Comparisons of review studies of vena caval filter placement (1995 – 2004)

Author	*Total Number*	*Prophylactic Indications*	*Filter Mal-position*	*Caval Thrombosis*	*Recurrent DVT*	*Recurrent PE*
Magnant et al. [6]	84	11%	4.7%	2.3%	1.2%	2.3%
Schleich et al.[2]	100	0	38%	7%	23%	3%
Langan et al. [18]	187	100%	0.5%	0	12.8%	0.5%
Athanasoulis et al. [3]	1,731	16.4%	-	2.7%	-	5.6%
Rogers et al. [20]	132	100%	38%	0.8%	7.5%	2.3%
Greenfield et al. [17]	293	100%	6.4%	2.3%	8.8%	1.7%
Current study	55	7.2%	7.2%	5.4%	5.4%	1.8%

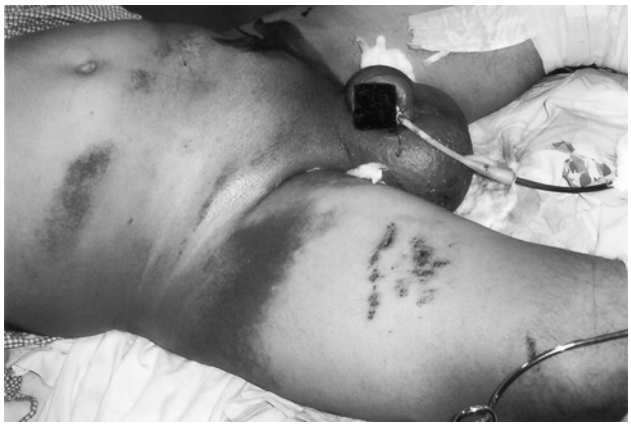

Fig 1. A 3-D reconstruction of CT scan of the pelvic bones showing bilateral acetabular and right iliac bone fractures (upper) and severe lower abdominal wall and scrotal soft tissue injury and hematoma (lower) in a high-risk multiple trauma patient.

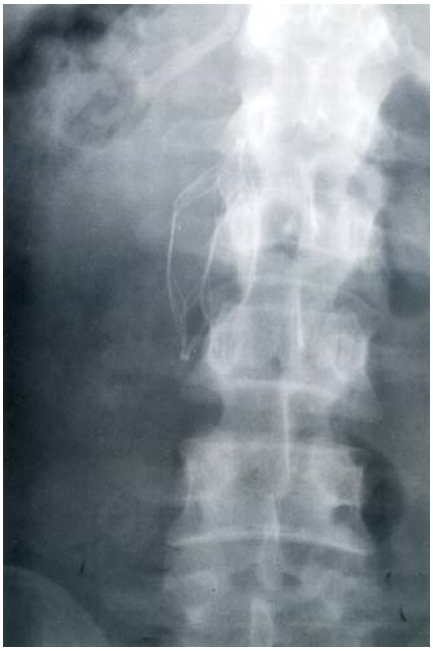

Fig 2. Trapease filter inserted in the IVC in a patient with DVT and PE secondary to antiphospholipid syndrome.

DISCUSSION

In spite of improvements in the diagnosis and treatment of thromboembolic disease, pulmonary embolism continues to be a major cause of morbidity and mortality. Patients with PE have a 3-month mortality rate of 18%.[40] Anticoagulation remains the preferred therapy for deep venous thrombosis; however, this form of treatment is either ineffective or contraindicated for some patients. For these patients, partial interruption of the vena cava via percutaneous filter placement has become the procedure of choice to protect against fatal PE.[41]

As the procedures to prevent fatal pulmonary embolism have become safer, more efficacious, and less morbid, the number of patients in whom the potential benefits of insertion of a vena cava filter outweigh the risks has become larger.[8] Many reports supported the liberalized use of vena caval filters in those patients who do not necessarily have one of the traditional indications for filter placement but are at a high risk of having a fatal pulmonary embolus.[8,42] A 20-year review by Greenfield and Proctor involving 642 patients revealed that the most common indications for filter placement were a contraindication to anticoagulation (45%), a complication of anticoagulation (20%), and prophylaxis (13%).[43] Our indications and results of filter insertion were similar to those reported by others Table 2.

DVT and PE are major causes of morbidity and mortality in victims of major trauma. Although the true incidence of DVT and PE in trauma patients is unknown, DVT documented by venography was found in 58% of major trauma patients and PE was found in autopsy of 16.5% in this patient population. In addition, it has been estimated that as many as 50% of trauma patients who die after PE would have otherwise survived to hospital discharge.[19] Because the diagnosis of PE in this patient population is notoriously difficult, and because this complication may present as sudden death, prophylaxis remains the primary mode of management of this problem. Multisystem trauma patients with solid organ injuries, extremity fractures, and head injuries, however, often pose a difficult dilemma for the trauma surgeon because of the inability to use standard preventive measures such as sequential compression devices and subcutaneous heparin. Consequently, these patient often receive either no prophylaxis in the early postinjury period or undergo placement of permanent vena cava filters.[19] The use of prophylactic vena cava filters in patients with trauma has been advocated in several clinical studies.[15-20, 44, 45] Rogers and his colleagues reported their 5-year follow-up of prophylactic vena cava filters in 132 high-risk trauma patients. They concluded that prophylactic vena cava filters can be placed safely with an acceptable rate of insertion-related DVT and long-term IVC patency.[20] Furthermore, Greenfield et al compared the outcomes of patients with trauma who had vena cava filters placed in the absence of venous thromboembolic disease with outcomes of patients with trauma who had filters placed after either DVT or PE and found no statistical significant difference in the outcomes between the two groups regarding new DVT, PE, or caval thrombosis. They also found that tilting or asymmetry of the filter legs had no correlation with recurrent PE. The investigators endorsed the use of prophylactic vena cava filters in patients with trauma without thromboembolism as it is associated with low incidence of adverse outcomes while providing protection from fatal pulmonary embolism. In addition the long-term stability of the filters provides reassurance with respect to its use in younger patients.[17] The trauma patient reported in our study had sustained severe pelvic fracture, a right trimaleolar (Pott's) fracture, and severe lower abdominal wall and scrotal soft tissue injury and hematoma (Fig. 1). Institution of prophylactic subcutaneous low-molecular weight heparin seven days postinjury resulted in increase in the size of the hematoma with concomitant drop in hemoglobin and hematocrite levels. A titanium Greenfield filter was placed as a prophylaxis against PE.

Vena cava filters are placed routinely in the infrarenal portion of the IVC. However, in certain situations, it is advisable to position the device above the level of the renal veins. The most common indications include vena caval thrombosis to or above the level of the renal veins or thrombus within the renal veins, avoidance of uterine compression against the filter during a current or anticipated pregnancy, and propagating thrombus on a previously placed filter.[9,10,46] Greenfield and Proctor reported their 25 years experience with suprarenal placement of Greenfield filters in 148 of 1932 patients (7.6%), and 73 patients (49%) had follow-up. The authors found that no cases of renal dysfunction were related to filter placement and the rates of recurrent PE and long-term caval occlusion were 8% and 5%, respectively, which did not differ statistically from the rates for patients with infrarenal filters. They concluded that Greenfield filters placed in the suprarenal IVC are safe and effective both in young female patients of child-bearing potential and in all patients with appropriate indications for suprarenal placement.[9] Athanasoulis et al in their review of a 26-year single-center clinical experience with IVC filters inserted in 1765 patients also found no renal dysfunction in 46 patients (2.6%) with suprarenal IVC filters.[3] In our study there was no renal dysfunction in those patients who had suprarenal IVC placement because of caval thrombosis.

In the majority of patients, thrombus in the deep veins of the lower extremity is the primary source of PE. It is now recognized that PE complicates upper extremity DVT in 12% – 16% of cases. There have also been several reports of fatal PE due to upper extremity DVT. Percutaneous filter insertion in the SVC is technically more demanding than insertion in the IVC because of the relatively small area for filter deployment.[11] Complications of IVC filter placement could potentially be more severe for SVC filter placement. Filter migration is more likely to result in an intracardiac position. Caval perforation may result in cardiac or aortic injury. SVC occlusion is more likely to result in substantial morbidity because of the reduction in potential collateral vessel pathways. In addition, the safety of central venous or Swan-Ganz catheter placement after SVC filter placement is of particular concern. In a report of 41 patients with SVC filters placement followed for a median of 12 weeks, Spence et al found no complications such as filter migration, dislodgement, or fracture occurred. No patients developed clinical evidence of PE due to upper extremity thrombosis or superior vena cava syndrome, and Swan-Ganz and central venous catheters were placed subsequent to filter placement in 23 patients (56%) without complications. The authors concluded that percutaneous filter placement in the SVC is a safe and effective method for preventing symptomatic PE due to acute upper extremity DVT in patients in whom therapeutic anticoagulation has failed or is contraindicated.[11] Other investigators also reported similar experience with SVC filter placement.[12,13] The single patient in our study who underwent SVC filter placement had upper extremity DVT and had no complications or PE developed after insertion of the filter.

Patients undergoing treatment for cancer have a high risk and prevalence of venous thrombosis and frequent

contraindications to anticoagulation therapy that lead to placement of caval filters. Schwarz et al reviewed their experience at the Memorial Sloan-Kettering Cancer Center with filter placement in 182 patients with cancer. Sixty three per cent of patients had stage IV disease. Six patients (3%) developed complications including malposition in three patients and one each of migration, arrhythemia, and wound infection. There was no death. After filter insertion, four patients developed PE and 11 patients developed DVT. The authors concluded that IVC filter placement in patients with advanced cancer and thrombotic complications is safe, well tolerated and can offer effective therapy/prophylaxis with a low incidence of treatment failure.[27] Jarrett et al, and Spence et al, however, argued that although recurrent thromboembolic events are rare after caval filter placement in patients with malignant disease, survival is short in most patients with stage IV disease and prevention of PE may be of little clinical benefit and a poor utilization of resources. Oncologists should consider these sobering results when requesting filter placement in patients with advanced malignant disease.[11,26] Likewise, in this study five out of nine patients with malignancy died between two weeks and one year after filter insertion as a result of their malignant disease.

In conclusion, placement of vena cava filters is safe and effective for the current indications given a reasonable life expectancy of patients with advanced cancer or severely ill patients. Several studies including ours support the use of vena caval filters in those patients who do not necessarily have one of the traditional indications for placement of filter but are at a high risk of having a fatal pulmonary embolus. However, randomized controlled trials may lead to improved risk stratification and limit the number of unnecessary filter insertions.

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