Role of Optional (Retrievable) IVC Filters in Surgical Patients at Risk for Venous Thromboembolic Disease

Babak Sarani, MD, Albert Chun, MD, Anthony Venbrux, MD

Despite increased awareness of the prevalence of deep venous thrombosis (DVT) and pulmonary embolism (PE), and advances in the use of pharmacologic agents for prophylaxis against venous thromboembolic disease (VTED), the incidence in hospitalized patients remains high. This is especially true for surgical patients. It is estimated that there are 94,000 new symptomatic cases of PE per year in the US. This translates to an approximate rate of 1 event per 1,000 patients per year.[1] It is estimated that PE is the third leading cause of death in the US, accounting for over 50,000 to 100,000 deaths per year.[1,2] PE is also the most common preventable cause of death in surgical patients.[2] It is estimated that 80% to 90% of PEs originate as lower extremity, pelvic, or caval DVT. Surgical patients are at increased risk for developing VTED because such patients have one or more of the classic triad of risk factors for thrombosis, as described by Virchow in 1850, ie, endothelial injury (which either predates the operation or is a result of the operation itself), a hypercoagulable state resulting from an underlying condition (eg, malignancy), or stasis of blood flow associated with lack of physical activity secondary to pain or injury.

Fatal PE has been reported in 0.5% to 1% of patients undergoing abdominal operation or major orthopaedic operation.[3-5] Although heparin compounds have been shown to be effective in decreasing incidence of DVT and PE, a small percentage of patients at high risk for VTED will either not be candidates for anticoagulant therapy or will suffer a PE despite adequate medical therapy. Such patients are considered appropriate candidates for placement of an IVC filter. Established indications for placement of an IVC filter are listed in Table 1.

All vena cava filters are efficient at preventing recurrent PE (< 1% incidence),[6,7] but the problem of underlying DVT is not addressed with use of caval filters. Retrospective reports published in the literature have suggested an increased rate of DVT after longterm insertion of IVC filters. Only a single prospective study reports a statistically higher rate of DVT at 2 years in those patients with a vena caval filter compared with controls.[6] The cause is unclear but might be from venous hypertension resulting from thrombosis at the filter site. This suggests that the ideal filter should be removable so as to minimize longterm risk of DVT, while providing protection against PE. Such filters are now commercially available, although there are no studies evaluating the rate of DVT after placement and removal of an IVC filter.

This article will review risk factors for VTED in surgical patients, review efficacy and complications of IVC filters, and examine the role of new "optional" IVC filters in this patient population, based on a review of available medical literature. For the latter, a computer search using Medline and PubMed was performed using these keywords: retrieval (temporary, optional) inferior vena cava filter, deep venous thrombosis and surgery, DVT and spinal injury, DVT and orthopaedic surgery, pulmonary embolism, inferior vena cava filter complication, insertion site DVT, and anesthesia and deep venous thrombosis. The authors chose to discard articles before 1990 because the earliest optional IVC filter still in use was approved in Europe in 1992. The only exceptions to this are articles cited to provide a historic perspective as to the cause and treatment of VTED.

RISK FACTORS FOR DVT AND PE IN THE SURGICAL PATIENT

Surgical patients are at risk for development of DVT, but the level of risk varies, depending on patient demographics and type of operation performed. Table 2 sum-

Competing Interests Declared: None by Drs Babak Sarani and Albert Chun. Anthony Venbrux has received prior honoraria for lectures from Bard Peripheral Vascular, Cook, Inc, and Cordis Endovascular.

Received February 22, 2005; Revised July 25, 2005; Accepted July 26, 2005.
From the Department of Surgery (Sarani) and Department of Radiology, Interventional Radiology Division (Chun, Venbrux), The George Washington University, Washington, DC.
Dr Sarani's current address is Department of Surgery, Division of Traumatology and Surgical Critical Care, University of Pennsylvania, Philadelphia, PA 19104-3335.
Dr Chun's current address is Brigham and Women's Hospital, Division of Angiography and Interventional Radiology, 75 Francis St, Ste SR-343, Boston, MA 02115.
Correspondence address: Anthony Venbrux, MD, George Washington University Medical Center, 900 23rd St, NW, Ste G2092, Washington, DC 20037.

ISSN 1072-7515/05/$30.00
doi:10.1016/j.jamcollsurg.2005.07.014

Abbreviations and Acronyms

DVT = deep venous thrombosis
GTF = Günther Tulip Filter
PE = pulmonary embolism
VTED = venous thromboembolic disease

marizes the majority of known risk factors for DVT.[8,9] Table 3 depicts the risk for VTED in patients undergoing various operations.[2]

Effective regimens to protect against development of DVT include use of sequential compression devices and medical therapy. The latter most commonly includes use of low-dose heparin or low-molecular-weight heparin.[2,10-12] There is a range of reported efficacy with prophylactic use of compression devices, drug therapy, or both, because most DVTs are asymptomatic.[13,14] Such measures decrease the incidence of venographically evident DVT from > 20% to 8%, and the rate of clinically evident PE by 75% to 90% in most general surgery patients at risk for VTED.[2]

Although it is difficult to precisely measure the level of risk for developing DVT or PE in a specific patient, it is generally agreed that patients undergoing bariatric operations or operations for malignant, orthopaedic, neurosurgical, or traumatic conditions, acute spinal cord injury, and those with an inherent hypercoagulable state should be protected using both sequential compression devices and pharmacologic measures. For example, a patient who has sustained multiple long-bone fractures or other severe traumatic injuries has a 35% to 65% incidence of developing DVT, and the incidence of a fatal PE in such a patient without prophylaxis is 10% to 30%.[15] Heparin therapy will be of limited use or contraindicated in 1% to 4% of such patients because of presence of ongoing hemorrhage, heparin-induced thrombocytopenia, a large thrombus in the IVC (ie, free-floating thrombus), limited cardiopulmonary reserve, or presence of progressive VTED despite anticoagulant therapy. Such patients are best treated by placement of an IVC filter.

Table 1. Indications for Placement of an IVC Filter

Contraindication to anticoagulation
Recent major operation
Intracranial hemorrhage
Coagulopathy
Major risk of falling
Complication of anticoagulation
Bleeding
Failure of anticoagulation
Large free-floating clot loosely attached to IVC wall
Limited cardiopulmonary reserve

Table 2. Risk Factors for Deep Venous Thrombosis and Pulmonary Embolism[8,9]

Endothelial injury
Prolonged use of a central line
Operation (especially orthopaedic, abdominopelvic, neurosurgical)
Long-bone fractures
Severe hypertension
Trauma
Intravenous drug abuse
Hypercoagulable state
Carcinoma
Factor V (Leiden) mutation
Protein C or S deficiency
Antithrombin III deficiency
Excessive factor VIII
Plasminogen deficiency
Dysfibrinogenemia
Hyperhomocystinemia
Cigarette smoking
Estrogen therapy (oral contraception or hormone-replacement therapy)
Tamoxifen therapy
Antiphospholipid syndromes
Nephrotic syndrome
Obesity
Stasis
Immobilization
Obesity
Pregnancy
Prolonged bed rest
Spinal injury/paralysis
Any operation over 2 h in length
Other
History of thromboembolism
History of stroke or congestive heart failure
Age > 60 y

ROLE OF IVC FILTERS IN SURGICAL PATIENTS

Because of the known association between DVT and PE, and the high mortality associated with PE, surgical interruption of the IVC was first proposed as a method of VTED prevention by Trousseau in 1868 and surgically performed by Bottini in 1893.[7] Implantable IVC filters first became available in the 1960s and their clinical use