Inferior Vena Cava Filter Placement in Orthopedic Surgery

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Abstract

Inferior vena cava (IVC) filters were developed for the treatment of venous thromboembolism but in high-risk patients are often used for prophylaxis instead.

In the study reported here, we reviewed all the orthopedic surgery cases in which IVC filters were used at our institution in 2005. Charts were analyzed and patients contacted by telephone for long-term follow-up. IVC filters were used in 90 (0.96%) of the 9348 inpatient orthopedic surgeries.

Sixty-one percent of filters were placed for prophylaxis, although, only 42% of patients with prophylactic filters had a contraindication to anticoagulation. Eighty-one percent of patients with prophylactic filters who received anticoagulation received warfarin. Ratios of prophylactic-to-treatment filters were 3.25 for fracture surgeries, 2.1 for arthroplasties, and 0.89 for spine surgeries. Five percent of patients with prophylactic filters developed deep vein thrombosis. Fifty-two percent of filters were retrievable, but only 40% of those were removed a mean of 5.1 months (SD, 3.9 months) after placement. Filter removal was associated with complications in 11% of patients, and in another 10% the filter could not be removed. Forty-one patients were contacted a mean of 21 months (SD, 3 months) after filter placement. Only 32% of those who still had filters were on anticoagulation at follow-up.

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There is considerable debate over what constitutes an appropriate indication for inferior vena cava (IVC) filter placement. The only broadly accepted indication is for the treatment of acute venous thromboembolism (VTE) in a patient who has a contraindication to anticoagulation or who has recurrent thromboembolism despite adequate anticoagulation.[1] Although IVC filters were developed for the treatment of VTE, they are increasingly being used for prophylaxis in high-risk patients, such as those who undergo high-risk surgery or have major trauma, with or without concomitant pharmacologic anticoagulation.[2] There are few high-quality studies supporting IVC filter use for either approved or nonapproved indications. An analysis of the medical literature on IVC filter use between 1975 and 2000 found that 65% of studies were retrospective or case reports.[3] Despite the paucity of data, IVC filter use has increased exponentially since the Greenfield filter was introduced in the early 1970s. Forty-nine thousand IVC filters were placed (9000 for prophylaxis) in the United States in 1999, as compared with 2000 filters in 1979.[4] Given that each filter costs approximately $5,000, this has economic as well as clinical implications.

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Few studies have addressed IVC filter use in orthopedic surgeries specifically. Despite the absence of data, many orthopedists believe IVC filters are indicated in patients at high risk for VTE, particularly when there are contraindications to pharmacologic anticoagulation. In the absence of anticoagulation, risk for venographic proximal deep vein thrombosis (DVT) after joint arthroplasty or hip fracture surgery is 5% to 36%, and risk for symptomatic pulmonary embolism (PE) is 0.9% to 28%.[5] Risk for VTE after spine surgery is lower than this, but rates of PE after lumbar fusion have been reported to be as high as 2.2%.[5,6] Although rates of postoperative VTE can be reduced dramatically through use of effective pharmacologic prophylaxis, orthopedists sometimes turn to IVC filter placement when there is a contraindication to anticoagulation or when there are additional risk factors for clot.

Table I. Reason for Inferior Vena Cava Filter Placement

	Venous Thromboembolism			
	Treatment		Prophylaxis	
Surgery (n)	n	%	n	%
Arthroplasty (34)	11	32	23	68
Spine (36)	19	53	17	47
Fracture (17)	4	24	13	76
Other (3)	1	33	2	67
Total (90)	**35**	**39**	**55**	**61**

The goal of this study was to analyze IVC filter use in patients undergoing orthopedic surgery. Gaining an understanding of current practice is important because it will aid in the design of clinically relevant prospective IVC filter trials. It also will help orthopedic departments formulate guidelines for IVC filter use now while data from prospective trials are lacking.

Materials and Methods

This was a retrospective cohort study. Patients were selected from an interventional radiology database that includes all patients undergoing IVC filter placement at our institution. Each patient in the database who had an IVC filter placed either before or after orthopedic surgery at the Hospital for Special Surgery (HSS) in 2005 was included in the study. There are no formal guidelines for IVC filter placement at HSS, so the decision to place a filter was made by the orthopedic surgeon, usually in consultation with an internist. Filter type, date of filter placement and removal (if applicable), and any complications of those procedures were determined from the interventional radiology database. The patients' inpatient medical records were reviewed to determine demographics, surgery type, IVC filter indication, anticoagulants used, and whether VTE occurred before or after filter placement. Patients were contacted by telephone a minimum of 1 year after the index surgery. The total number of inpatient procedures performed at HSS in 2005 was determined from the HSS operating room database, as was the total number of arthroplasties, spine surgeries, and fracture surgeries. The study was approved by the institutional review board at HSS.

Results

Ninety orthopedic surgery patients received IVC filters at our institution in 2005: 55 for VTE prophylaxis and 35 for VTE treatment. That year, 9348 patients underwent nonambulatory orthopedic surgery at the hospital—including 2658 hip arthroplasty, 2547 knee arthroplasty, 1750 spine, and 163 acetabular, 254 hip, and 1723 lower extremity fracture patients—resulting in an overall IVC filter placement rate of 0.96%. Of the 90 filter patients, 47 were female and 43 male. Mean age was 62.8 years (SD, 15.7 years). Thirty-four filter patients underwent arthroplasty (14 hip, 20 knee), 36 had spine surgery (26 posterior lumbar decompression and/or fusion, 5 combined anterior and posterior fusion, 3 multilevel cervical decompression and fusion, 1 anterior decompression/fusion, 1 other procedure), 17 had fracture surgery (10 acetabulum, 2 hip, 2 femur, 2 tibia, 1 multiple fractures), and 3 had other orthopedic surgeries (1 hemipelvectomy for cancer, 2 ankle surgeries).

Rates of IVC filter placement were 6% in acetabular fracture patients, 2.1% in spine surgery patients, 0.8% in hip fracture patients, 0.65% in arthroplasty patients, and 0.2% in lower extremity fracture patients. The indications for filter placement are listed in Table I. Except among spine surgery patients, the majority of patients received an IVC filter for prophylaxis rather than treatment of VTE. Ratios of prophylactic-to-treatment filters were 3.25 for fracture surgeries, 2.1 for arthroplasties, and 0.89 for spine surgeries.

Among the patients who received a filter for treatment of VTE, 80% had a contraindication to anticoagulation. In 74% of spine surgery patients, the contraindication was the recent spine surgery itself. (It is the general policy of the spine service at our institution not to use anticoagulants in the first week after surgery.) Other reasons for therapeutic IVC filter placement (noted only in arthroplasty patients) were bleeding on anticoagulation, failure of anticoagulation, and saddle embolus. Table II lists the percentages of patients with therapeutic IVC filters receiving concomitant anticoagulation, and the anticoagulants used. Despite the contraindication to full-dose anticoagulation documented in the majority of these patients, 63% of them received some form of anticoagulation, most commonly warfarin. The fracture patients with therapeutic filters all experienced

Table II. Anticoagulation After Inferior Vena Cava Filter Placement for Treatment of Venous Thromboembolism

	Anticoagulation							
	None		Warfarin		Unfractionated Heparin		LMWH Plus Warfarin	
Surgery (n)	n	%	n	%	n	%	n	%
Arthroplasty (11)	2	18	5	45	0	0	4	36
Spine (19)	6	32	8	42	1	5	4	21
Fracture (4)	4	100	0	0	0	0	0	0
Other (1)	1	100	0	0	0	0	0	0
Total (35)	**13**	**37**	**13**	**37**	**1**	**3**	**8**	**23**

Abbreviation: LMWH, low-molecular-weight heparin.

Table III. Indication for Prophylactic Inferior Vena Cava Filter Placement

	Indication									
	Prior VTE		Malignancy		Other		Unknown		Contraindication to Anticoagulation	
Surgery (n)	n	%	n	%	n	%	n	%	n	%
Arthroplasty (23)	20	87	2	7	1	4	0	0	2	9
Spine (17)	10	59	3	18	5	29	1	6	17	100[b]
Fracture (13)	0	0	0	0	4	31	6	46	3	23
Other (2)	1	50	1	50	0	0	0	0	1	50
Total (55)[a]	**31**	**56**	**6**	**11**	**10**	**18**	**7**	**13**	**23**	**42**

Abbreviation: VTE, venous thromboembolism.
[a]Some patients had more than 1 risk factor, or 1 risk factor plus 1 contraindication.
[b]Spine surgery itself was considered a contraindication to anticoagulation.

Table IV. Postoperative Anticoagulation in Patients With Prophylactic Inferior Vena Cava Filters

	Anticoagulation							
	None		Warfarin		LMWH		LMWH Plus Warfarin	
Surgery	n	%	n	%	n	%	n	%
Arthroplasty (23)	3	13	16	70	0	0	4	17
Spine (17)	14	82	3	18	0	0	0	0
Fracture (13)	6	46[a]	5	38	2	15	0	0
Other (2)	1	50	1	50	0	0	0	0
Total (55)	**24**	**44**	**25**	**45**	**2**	**4**	**4**	**7**

Abbreviation: LMWH, low-molecular-weight heparin.
[a]One of these patients received aspirin as prophylaxis.

VTE before surgery, and, therefore, did not receive anticoagulation immediately after filter placement.

The indications for prophylactic IVC filter placement are listed in Table III. Among arthroplasty and spine surgery patients, a history of VTE was the most common indication for filter placement. In 6 of 8 acetabular fracture patients, there was no documented indication for filter placement. Table IV lists the percentages of patients with prophylactic filters who received concomitant anticoagulation, and the anticoagulants used. Only 42% of the patients with a prophylactic filter had a contraindication to anticoagulation. Eighty-one percent of those who received anticoagulation received warfarin.

Three patients with prophylactic filters developed VTE while in the hospital. The first, a knee arthroplasty patient, received warfarin after surgery and had a symptomatic DVT and PE on postoperative day (POD) 2. Another knee arthroplasty patient on warfarin was found to have an asymptomatic DVT on screening lower extremity ultrasound on POD 2. The third patient, who had an acetabular fracture, developed symptomatic DVT on POD 8, or 2 days after warfarin had been started.

Of the 90 filters in this study, 42 were permanent (30 Vena Tech, 11 Bard, 1 Simon Nitinol), and 47 were retrievable (44 Bard Recovery, 3 Günther Tulip); 1 filter type could not be determined. There were no complications of filter placement. Nineteen (40%) of the 47 patients with retrievable filters had the filters removed a mean of 5.1 months (SD, 3.9 months) after placement, which represents 21% of the entire patient cohort. Filter removal was associated with complications in 2 cases (11%). One patient experienced a carotid artery puncture during catheter insertion but did not suffer any sequelae of this. In the other case, 2 broken filter limbs were noted to have migrated to the right atrium and lung. Filter removal could not be performed in 2 additional patients, 1 for technical reasons, and 1 because 2 of the filter limbs were noted to be extraluminal.

Forty-one patients were contacted by telephone a mean of 21 months (SD, 3 months) after filter placement. Ten (32%) of the 31 patients who still had an IVC filter in place at follow-up were still on anticoagulation, as were 3 (33%) of the 10 patients without a filter. None of these patients reported VTE or bleeding since discharge. Three patients had died after filter placement: 2 of metastatic cancer and 1 of congestive heart failure.

Discussion

In this study, IVC filters were used in almost 1% of orthopedic surgeries and were used for VTE prophylaxis, not treatment, in more than 60% of cases, despite the fact that only 42% of patients with a prophylactic filter had a contraindication to anticoagulation. Patterns of IVC filter placement differed among orthopedic subspecialties. Fracture patients had a high rate of IVC filter placement, largely accounted for by the 6% placement rate in patients with acetabular fracture. Overall, however, arthroplasty and spine patients predominated in our study—most likely a reflection of the volume and type of surgery performed most often at our institution. Of the patients who underwent spine surgery, 2.1% received IVC filters, largely because of a fear that anticoagulants given in

the first week after surgery might result in spinal or epidural hematoma. A history of VTE was the risk factor identified in 59% of spine surgery patients who received a prophylactic IVC filter. Filters were placed in 0.65% of arthroplasty patients; in 68% of these cases, the filters were for prophylaxis. A history of VTE was the risk factor identified in 87% of these cases.

Three patients experienced DVT after prophylactic filter placement—resulting in a 12% DVT rate among acetabular fracture patients and a 9% DVT rate among arthroplasty patients who received prophylactic filters. In these cases, DVT may have been caused by suboptimal anticoagulation. Only 54% of fracture patients with prophylactic filters received an anticoagulant after surgery, despite the fact that only 23% had a contraindication to anticoagulation. Of arthroplasty patients, 70% received warfarin, but none received low-molecular-weight heparin.

None of the patients in this study had complications of filter placement, but 11% experienced complications of filter removal, and 10% with retrievable filters could not have them removed. Of the patients who still had filters and were contacted a mean of 21 months (SD, 3 months) after filter placement, only 32% were on anticoagulation. Although none of these patients reported VTE after discharge, a large percentage were lost to follow-up, making assessment of long-term VTE risk difficult.

The decision to place an IVC filter for VTE prophylaxis depends on analysis of the patient's risk for VTE and the risk and benefit associated with IVC filter placement itself. According to a Cochrane review of the literature, mortality related to filter insertion occurs in 0.12% of patients, IVC perforation in 9% to 24%, and vena cava thrombosis in 4% to 30%.[7] Most studies of IVC filters provide incomplete or no follow-up after the index hospitalization. Not surprisingly, these studies report very few complications, such as delayed VTE or filter thrombosis.[8,9] One exception was a study of long-term results of Vena Tech LGM filter placement, with its finding of only 66.8% filter patency at 9 years.[10]

Filter retrieval can eliminate the possibility of long-term filter-related risk. The retrievable Günther Tulip IVC filter became available in Europe in 1992, in Canada in 1998, and in the United States in 2003. Other retrievable filters are OptEase and Recovery. Depending on the filter used, retrieval can be done 23 to 134 days after placement,[11] or even later, as shown in our study. Retrievability of filters remains largely theoretical, however, as studies have found very low retrieval rates, on the order of 13% to 52%,[8,12,13] comparable to the 40% seen in our study.

The literature on IVC filter use in high-risk trauma patients is extensive. Some studies have suggested that IVC filters are associated with lower VTE and mortality rates compared with historical controls, whereas others have suggested higher VTE and mortality rates associated with filter placement.[14-16] In our study, acetabular fracture was the most common trauma-related indication for IVC filter placement. The incidence of preoperative DVT has been shown to be high in such patients,[17,18] and, in one study, Webb and colleagues[19] found a lowering of VTE risk with prophylactic IVC filter placement. This trial was flawed, however, by suboptimal chemoprophylaxis given to the control group.

Few studies have addressed IVC filter placement (for prophylaxis or treatment) in other types of orthopedic surgeries. Rosner and colleagues[20] evaluated 22 high-risk patients who received prophylactic IVC filters before major spinal reconstruction. Patients who received filters had no PE, however, 9% suffered a DVT. The PE rate was 12% in the matched retrospective cohort but was 0% at another institution.[20] Vaughn and colleagues[21] described 66 patients who had hip or knee arthroplasty and received an IVC filter; 1 filter patient in this study had a fatal PE. Austin and colleagues[22] described 95 arthroplasty patients who received IVC filters between 1997 and 2003; 5 had recurrent DVT, 2 had recurrent PE, and 15 complained of persistent, painful lower extremity swelling.

In the only reported prospective randomized controlled trial of IVC filter use, Decousus and colleagues[23] randomized 400 patients with acute proximal DVT to permanent IVC filter or no filter, in addition to therapeutic anticoagulation with heparin followed by warfarin for at least 3 months. Although there was a significant reduction in the rate of symptomatic PE at day 12 in the filter group compared with the controls, there was no statistical difference between the groups' PE rates at 2 years, and mortality was not reduced by filter use. Eight-year follow-up data demonstrated PE in 6.2% of patients in the filter group versus 15.1% in the control group but more symptomatic DVT in the filter patients than in the controls. There was no difference in mortality, postthrombotic syndrome, or bleeding complications.[24] Fifty percent of patients were no longer on anticoagulation at 8 years, which may have contributed to DVTs in the patients with filters.

In the absence of good prospective controlled trials, national consensus guidelines recommend against use of filters, except in patients with acute VTE and a contraindication to or failure of anticoagulation.[1] At the

"Retrievability of filters remains largely theoretical, however, as studies have found very low retrieval rates, on the order of 13% to 52%"

same time, the literature points to the possibility of at least short-term lowering of PE risk with filter use. This suggests a possible benefit to placing retrievable filters for VTE prophylaxis in very high risk patients with a contraindication to anticoagulation, assuming that measures are taken to ensure the filters are removed. Filter removal would eliminate the risk for long-term filter complications, such as DVT and filter occlusion, though filter removal itself is not risk-free, as demonstrated in our study.

Controlled trials comparing IVC filter use and optimal chemoprophylaxis are clearly needed so that patients can be assured their treatment optimizes benefit and minimizes risk. While awaiting such trials, hospitals should consider creating guidelines for IVC filter placement so that unnecessary use of the devices can be avoided. The literature suggests that patients who undergo orthopedic surgery, are at high risk for VTE, and do not have a contraindication to anticoagulation should be managed with prophylactic anticoagulants rather than an IVC filter. Whenever possible, patients who receive a filter should also receive anticoagulation, given the increased DVT risk associated with filter use.

Authors' Disclosure Statement

Dr. Trost wishes to note that he is a consultant for B. Braun and a speaker for Cook Medical. The other authors report no actual or potential conflict of interest in relation to this article.

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