

Current Status of the Retrieval Rate of Retrievable Vena Cava Filters in a Tertiary Referral Center in Korea

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Purpose: The purpose of this study was to review the daily practice of inferior vena cava filters (IVCFs) in a tertiary referral center in Korea and to reveal the retrieval rate and the methods for improving it.

Materials and Methods: Through the electronic medical record system, a retrospective review was performed on 115 consecutive patients who underwent placement of retrievable IVCFs between February 2000 and January 2011 in Seoul National University Hospital.

Results: IVCF placement was done in 115 cases (113 patients). There were 68 men (59.1%), and the mean age was 58.5±15.5 years (range, 10-96 years). The affiliated departments were Vascular Surgery (57 cases, 49.6%), and Internal Medicine (20 cases, 17.4%). Advanced malignancy was the most commonly associated disease (n=30, 26%). The indications for IVCF placement were categorized; absolute indications in 36 cases (31.3%), relative indications in 78 cases (67.8%), and prophylactic use in 1 case (0.9%). The most common indications were thrombolysis/thrombectomy for ilio caval deep vein thrombosis (DVT) (n=55, 47.8). Of the 115 filters, 68 were retrieved (retrieval rate, 59%). The most common cause of non-retrieval was chronic high risk of venous thromboembolism in 24 patients (51%), followed by residual proximal DVT (n=7, 15%), and negligence by unknown reasons (n=6, 13%).

Conclusion: To improve the retrieval rate, the number of follow-up losses to vascular specialists must be decreased, which can be achieved by establishment of a dedicated IVC filter clinic, implementation of a filter registry, and regular education for medical teams and patients along with their families.

Key Words: Vena cava filters, Venous thrombosis, Pulmonary embolism, Venous thromboembolism

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INTRODUCTION

For patients with venous thromboembolic disease, anticoagulation is the principal therapy. However, when anticoagulation is contraindicated or when bleeding complication develops during anticoagulation or recurrent

venous thromboembolism (VTE) occurs despite therapeutic anticoagulation, inferior vena cava filters (IVCFs) are useful for the prevention of pulmonary embolism (PE). Currently, 3 different types of IVCFs can be used, including temporary, retrievable (optional), or permanent filters [1,2].

In a randomized controlled study, permanent IVCFs

reduced the risk of PE in a short period, but the risk of complications increased in the long-term period, such as IVC thrombosis, recurrent VTE, thrombophlebitis, venous stasis disease, and IVCF penetration into adjacent organs [3]. In order to solve these problems, retrievable IVCFs have been developed. Temporary use of retrievable IVCF is a simple and safe method with a high success rate in preventing fatal PE and served as an effective bridge to anticoagulation. However, many authors claimed that the frequency of retrievable IVCF insertion had increased, but the retrieval rate was quite low [4–6]. In addition, indwelling retrievable IVCFs were associated with significantly higher complication rates than permanent filters [7]. Therefore, early retrieval of filters is recommended as soon as anticoagulation therapy restores.

The purposes of this study were to analyze the real-world practice pattern of IVCF usage in a single tertiary referral center in Korea, to reveal filter-related complications and the retrieval rate, and to define factors related to the retrieval rate.

MATERIALS AND METHODS

We retrospectively reviewed the electronic medical records and imaging studies of consecutive patients undergoing IVCF placement at Seoul National University Hospital between February 2000 and January 2011. This study received the approval of the institutional review board (IRB No. H-1412-0590632). The procedures were performed in radiologic angiosuites by the intervention radiologists under local anesthesia. Device selection was done depending on the preference of interventionist.

Patient demographic information, medical comorbidities, diagnosis, indication for filter placement, type of filters used, affiliated departments, and filter-related complications were analyzed.

The filters were classified as temporary, permanent or retrievable [1,2]. A temporary filter is attached to a wire or a catheter and should usually be removed. A permanent filter is defined as a device that is designed for permanent placement. A retrievable filter is similar to a permanent filter and can be used for permanent protection. However, it has additional features such as retrieval hooks or strut/fixation hooks, allowing percutaneous removal from the body.

There are 3 categories of indications for IVCF placement [2]. Absolute indications (proven VTE) are as follows: recurrent VTE (acute or chronic) despite adequate anticoagulation, contraindication to anticoagulation, complications of anticoagulation, inability to achieve/maintain therapeutic anticoagulation. Relative indications (proven VTE) are as follows: ilio caval deep vein thrombosis (DVT), large free-floating proximal DVT, massive PE treated with thrombolysis/thrombectomy, chronic PE treated with thrombo-endarterectomy, thrombolysis for ilio caval DVT, VTE with limited cardiopulmonary reserve, recurrent PE with filter in place, poor compliance with anticoagulant medications, and high risk of complications of anticoagulation (e.g., ataxia, frequent falls). Prophylactic indications (no VTE, primary prophylaxis not feasible) are as follows: trauma patients with high risk of VTE, surgical procedures in patient at high risk of VTE, medical conditions with high risk of VTE.

Table 1. Indications for vena cava filter insertion

Category (%)	Indication	n (%)
Absolute indications (31.3)	Contraindication to anticoagulation	25
	Complication during anticoagulation	3
	Recurrent DVT/PE during anticoagulation	8
Relative indications (67.8)	Free-floating proximal thrombus	7
	Thrombolysis/thrombectomy for ilio caval DVT	55 (47.8)
	Acute PE treated with thrombolysis/thrombectomy	1
	Chronic PE treated with thromboendarterectomy	3
	VTE with limited cardiovascular reserve	11
	poor compliance	1
Prophylactic (0.9)	Severe trauma	0
	Severe surgical patient	1
	Severe medical disease	0
Total (100)		115

DVT, deep vein thrombosis; PE, pulmonary embolism; VTE, venous thromboembolism.

RESULTS

1) Patient demographics

IVCF placement was done in 115 cases (113 patients). Two patients underwent repeated IVCF insertion due to recurrent DVT after successful thrombolytic therapy with short-term IVCF insertion. There were 68 men (59.1%) and 47 women (40.9%). The mean age of the patients was 58.5 ± 15.5 years (range, 10–96 years). Except for 1 patient, 114 patients had VTE; DVT only in 58 cases (50.8%), DVT with PE in 47 cases (41.2%), renal cell carcinoma with tumor thrombi in 4 cases (3.5%), IVC thrombophlebitis in 3 cases (6%), and PE only in 2 cases.

The affiliated departments of the physicians who ordered the IVCF placement were as follows; Vascular Surgery (57 cases, 49.6%), Internal Medicine (20 cases, 17.4%), Neurosurgery (9 cases, 7.8%), Thoracic Surgery (7 cases, 6%), and Orthopedic Surgery (7 cases, 6%).

Associated diseases related to VTE were analyzed. Advanced malignancy was most common ($n=30$, 26%), followed by immobility ($n=12$, 10.4%), cerebrovascular accident ($n=4$, 3.5%), and infectious spondylitis ($n=3$, 2.6%).

2) Indications for filter placement

The indications for IVCF placement were categorized into 3 groups; absolute indications in 36 cases (31.3%), relative indications in 78 cases (67.8%), and prophylactic use in 1 case (0.9%). The most common indication was

thrombolysis/ thrombectomy for ilio caval DVT ($n=55$, 47.8%), followed by contraindication to anticoagulation and VTE with limited cardiovascular reserve (Table 1). Of the 115 filters, 68 were retrieved (retrieval rate, 59%) The mean implantation time of the retrieved filters was 21 days. The most common cause of non-retrieval was chronic high risk of VTE in 24 patients (51%), followed by residual proximal DVT ($n=7$, 15%), and negligence by unknown reasons ($n=6$, 13%).

3) Filter characteristics

The types of filters used were as follows: Gunter tulip (Cook Medical Inc., Bloomington, IN, USA) in 75 cases, Celect (Cook Medical Inc.) in 39 cases, and Optease (Cordis, Warren, NJ, USA) in 2 cases. The locations of the filters were infrarenal IVC in 105 cases (91.3%) and suprarenal IVC in 11 cases (9.6%). In 1 case of IVC thrombosis, a suprarenal filter was inserted, and thrombolysis was performed. Due to residual thrombi in the IVC, the suprarenal filter was retrieved and reinserted into the infrarenal IVC. One patient with filter-related IVC thrombosis was transferred from a regional hospital, and thrombolysis was performed with a retrievable suprarenal filter. Due to residual stenosis, the infrarenal filter was left in situ, and the suprarenal filter was removed (Fig. 1).

Filter-related complications developed in 5 cases, including 2 filter thromboses, 2 penetrations into the caval wall, and 1 retrieval failure. Two filters showed penetration into the vena cava wall with no symptoms, and 1 was retrieved



Fig. 1. Two Optease filters in the infrarenal and suprarenal inferior vena cava. After thrombolysis, the suprarenal vena cava was patent, but the infrarenal vena cava had remaining thrombus with stenosis near the infrarenal filter. Only the suprarenal filter was retrieved. (A) Simple X-ray, (B) venography.



Fig. 2. Filter penetration. One leg of the filter was observed outside the vena cava wall at different angles. The filter was retrieved with a meticulous technique without complications.

successfully by endovascular approach and the other was not retrieved due to remained thrombosis (Fig. 2). One filter was inserted in a patient with IVC thrombosis associated with tuberculous spondylitis, and attempt for filter removal after 2 months was unsuccessful due to severe adhesion.

4) Filter retrieval

Of the 115 filters, 68 were retrieved (retrieval rate, 59%). The mean implantation time of the retrieved filters was 21 days (median, 30 days; range, 3–229 days). Most of the filters (n=58, 85%) were removed within 30 days, and 10 filters were retrieved after 30 days, including 2 outliers of late filter retrieval after 138 and 229 days, respectively.

The causes for non-retrieval in 47 patients (41%) were analyzed. The most common cause was chronic high risk of VTE (n=24, 51%), followed by residual proximal DVT (n=7, 15%), negligence by unknown reasons (n=6, 13%), massive PE (n=3, 2.6%) and patient death (n=3, 2.6%). The negligence meant that the patient was followed up in the outpatient clinic, but the filter was not retrieved by unknown reasons. All of these patients were not consulted to the Vascular Surgery department, and the affiliated departments were neurosurgery in 3 cases, and the others included gynecology, thoracic surgery, and otolaryngology. Three patients died of other causes non-related to the filters within 30 days after filter placement due to osteosarcoma, bile duct cancer, and sepsis after total knee replacement.

DISCUSSION

IVCF placement is a popular treatment modality in patients with VTE to prevent PE in case of contraindication or failure of anticoagulation. Retrievable IVCFs are appealing because they can be removed after short-term use as a bridge to anticoagulation, or because they can be left as indwelling filters if the risk of PE prevails. However, the long-term safety of indwelling retrievable filters is unknown. In fact, most retrievable filters are not retrieved, but left in place permanently. Retrieval rates reported in the literature range from 4% to 50% [8–14]. Recently, Desai et al. [7] reported that indwelling retrievable filters were associated with significantly higher complication rates than permanent filters. They also recommended that long-term use of retrievable filters should be avoided, especially considering the younger population in whom they were placed.

In our series, only 1 filter was used for prophylaxis and most of the filters were used for therapeutic purposes. The most common indication was thrombolysis/thrombectomy for ilio caval DVT (47.8%), followed by contraindication to anticoagulation and VTE with limited cardiovascular reserve. In order to minimize possible fatal PE during thrombolysis/thrombectomy, retrievable IVCF placement was preferred in our center. A special subgroup of this category included renal cell carcinoma with tumor thrombi in the renal vein or IVC. In 4 cases in this series, suprarenal filters were inserted just before the operation, and all the filters were retrieved within 10 days after operation.

The filter retrieval rate in our center was 59%, and the mean implantation time of the retrieved filters was 21 days, which was much better than those of other reports indicating retrieval rates of 5%–40%. The most common cause of non-retrieval was chronic high risk of VTE (51%), followed by residual proximal DVT (15%), and negligence by unknown reasons (13%). Many of the high risk of VTE cases were advanced cancer patients. The negligence cases can be minimized by careful follow-up by vascular specialists. In addition, the plan for filter retrieval needs to be discussed with the affiliated doctors before filter placement. In patients who were seen in consultation with a vascular surgeon, filter placement and retrieval was well described. However, in other specialties, the need for filter removal and time-limitation for filter retrieval were usually overlooked and ignored. Thus, careful and systematic planning for placement, retrieval, and thorough follow-up should be initiated by vascular specialists.

Many studies have shown that the majority of retrievable filters were not removed, and they also suggested some methods for solving this problem. Meisner et al. [8] have shown an increased retrieval rate after establishment of an IVCF clinic. Kalina et al. [9] have reported that application of a filter registry can significantly increase the retrieval

rate. Irwin et al. [10] have suggested constructing a prospective data-collecting system for patient follow-up.

The limitations of this study are as follows. Because of the retrospective nature of the study, filter-related complications may have been underestimated, including filter tilting or migration. Furthermore, the regular follow-up of the patients was not conducted with the same protocol. The result of this study may not be applied to the general population due to its small number of cases in a single center.

CONCLUSION

The retrieval rate of retrievable IVCs in our hospital was 59%, and the most common cause of non-retrieval was chronic high risk of VTE (51%). Unfortunately, negligence of filter removal by unknown reasons was 13%, which can be minimized by a careful follow-up program by vascular specialists. To improve the retrieval rate, the number of follow-up losses to vascular specialists must be decreased, which can be achieved by establishment of a dedicated IVC filter clinic, implementation of a filter registry, and regular education for medical teams and patients along with their families.

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