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Blueprint for Implementing and Improving Eligible Inferior Vena Cava Filter Retrieval Across Institutions

Adam S. Nygard, M.D., Nick M. Hanna, M.D., Gerre A. Fiore, MSN, APRN, AGCNS-BC, CCRN, Aaron M. Rohr, M.S., M.D., Adam S. Alli, M.D., Zach S. Collins, M.D., Neville R. Irani, M.D.
The University of Kansas Health System, Kansas City, KS
Department of Interventional Radiology

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ABSTRACT

Introduction. Placement of removable inferior vena cava filters (rIVCFs) has increased, but this has not been accompanied by timely removal, with retrieval rates as low as 8.5% at some institutions. Failure to remove rIVCFs that were not medically necessary resulted in increased complications. This study discussed the development of an inferior vena cava (IVC) filter follow-up protocol.

Methods. A method to monitor IVC filter placement and retrieval was developed. A weekly report was generated detailing placement and removal of rIVCFs. A standardized retrieval calculator was utilized to determine efficacy of removal. An IVC filter Retrieval Assessment Form was developed. Managing physicians and patients with medically unnecessary filters were sent letters with a retrieval checklist and order form. If not removed within one year, additional letters were sent. Standardized IVC filter reporting templates were created and utilized after insertion of all filters with retrieval status. Letters eventually were built into the electronic medical record for direct routing.

Results. From 2015 to 2020, IVC filters were placed in 719 patients. Of those, 58% were eligible for retrieval. Initial rates of rIVCF removal in eligible patients were as low as 30-33% in 2015. The retrieval rate of eligible filters rose to 44% in September 2018. The rate of retrieval rose to 61% in January 2021.

Conclusions. Employing a systemic protocol to aid in follow-up of patients following rIVCF placement may improve rates of retrieval. Regular evaluation and revision of the process demonstrated a significant role in achieving an increase in retrieval rates.

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INTRODUCTION

Placement of removable filters (rIVCFs) has increased dramatically over the past decade, with prophylactic indications accounting for more than 50% of all filter placements.[1] Increasing use of rIVCFs has not been accompanied by follow-up and timely removal, with retrieval rates as low as 8.5% at some institutions.[2] Failure to remove rIVCFs that were not medically necessary have resulted in increased risk of complication, including embedment, scarring, fracture, penetration, and venous thromboembolism.[3]

Reasons for insufficient filter follow-up vary, whether the primary physician was unaware of its presence, because of prolonged dwell time risks, or the indwelling filter was simply forgotten (among many other reasons). It was hypothesized that implementing a protocol by which deployed filters were followed in a data set with prospective reminders sent to referring primary care physicians would result in improved eligible retrieval rates. Moreover, those filters not eligible for retrieval would be identified, resulting in closure for the patient.

METHODS

A systematic method was developed to monitor IVC filter placement and retrieval and facilitate patient follow-up through interdisciplinary communication. Institutional Review Board (IRB) approval was obtained. The patient participation in the study was voluntary and consent was obtained from each patient.

Beginning in 2015, a weekly report was generated prospectively detailing placement and removal of rIVCFs in the interventional radiology (IR) department at the investigators' institution. Information was stored in an electronic database and consisted of the patient's medical record number, filter placement date, indication for placement, patient age, clinical disposition, and likelihood that the filter would end up needing to be retrieved using a standardized retrieval calculator. This information was queried monthly, reviewed, and any filters in place 90 days or longer were analyzed using a novel IVC filter Retrieval Assessment Form (Figure 1) as well as the electronic medical record. The retrieval assessment form aided in determining appropriate candidates for filter retrieval. rIVCF's deemed no longer medically necessary initiated paper letters sent to the patient reminding them to consult their primary physician about potentially getting the filter removed. The managing physician also was notified with a retrieval checklist and order form (Figure 2). The letter sent to the managing physician would discuss risks associated with leaving unnecessary rIVCFs in place, including device migration, filter fracture, embolization (movement of the entire filter or fracture fragments to the heart or lungs), perforation of the IVC, lower limb deep vein thrombosis, and IVC occlusion.

Once the letter was sent, it was recorded in the database. Of note, patients who did not come to the investigators' institution for filter retrieval presumably did not get it removed at an outside health system unless specified by the patient. If it became known that a patient's filter was removed at an outside institution, they were excluded from the study results.

As the study progressed, data collection continuously was revised and improved. The most significant data collection improvement included the implementation of procedural dictation identifying the filter and the adaptation of a universal stratification mechanism to determine filter retrieval probability. Initially, a total tally of filters placed compared to filters removed was used to calculate retrieval rates. In 2018, data collection was revised to exclude deceased patients and those requiring filters permanently, allowing for more accurate results. Also beginning in 2018, if a filter was not retrieved within one year of the original letter being sent, additional letters were sent to both the patient and managing physician on an annual basis until the filter was removed or deemed permanent due to a change in clinical status. Standardized IVC filter dictation templates were created and utilized after insertion of all filters with retrieval status, which alerted clinicians to anticipate follow-up from the department. Lastly, the burden of letter generation, patient re-location, and time constraints resulted in letters being built

into the electronic medical record (EMR) at the investigator's institution (Epic™) allowing for direct routing. Electronic letters also were sent directly to patients through the myChart™ platform.

Patient Name		
MRN		
Age		
Sex	☐ Male	☐ Female
Filter Type, Brand/Model	☐ IVC	Brand _____ Model _____
Filter Placement Date		
IR Staff		
IP/OP Status	☐ IP	☐ OP
Clinical Indication		
Likelihood of Retrieval Calculator	_____ % Permanent	
IR staff Reviewing		
Date		
Retrieval Indicated?	☐ Yes	☐ No
Reason if not	☐ Comorbidities	☐ Other
Target	☐ Letter to Patient	☐ Letter to Provider
PCP or Managing Provider		
Medical History, ECOG score		
Current AC		
Notes		

Figure 1. IVC filter retrieval assessment form.

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IVC Filter Retrieval Readiness Checklist

- ☐ The patient successfully completed at least 2-3 weeks of anticoagulation
- ☐ Patients currently taking warfarin should have a stable INR and no evidence of bleeding
- ☐ If filter was placed for lower extremity VTE or prophylaxis, please complete lower extremity duplex venous ultrasound to confirm resolution or absence of thrombus
- ☐ The patient has no signs or symptoms of new, recurrent, or progressive VTE that may include:
  - Lower extremity VTE
    - Leg pain or tenderness of the thigh or calf
    - Leg swelling
    - Skin that feel warm to the touch around the painful area
    - Redness or streaks near the painful area
  - PE
    - Unexplained shortness of breath
    - Rapid breathing
    - Chest pain anywhere under the rib cage (may be worse with deep breathing
    - Fast heart rate
    - Light headedness or syncope
- ☐ ECOG Performance Status of 0-2

GRADE	ECOG PERFORMANCE STATUS
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work
2	Ambulatory and capable of all selfcare but unable to carry out any work activities; up and about more than 50% of waking hours
3	Capable of only limited selfcare; confined to bed or chair more than 50% of waking hours
4	Completely disabled; cannot carry on any selfcare; totally confined to bed or chair
5	Dead

- ☐ The patient is deemed no longer at risk for VTE

Please contact the Clinical Nurse Specialist, MSN, APRN, AGCNS-CCRN for Interventional Radiology at [EMAIL] for questions or feedback.

Figure 2. IVC filter retrieval checklist sent to primary care physician.

RESULTS

From 2015 to 2020, our institution's interventional radiology department placed IVC filters in 719 patients. Of those patients, 15% (n = 106) required filters permanently (did not need retrieval per the risk stratification calculator) and would not be eligible for removal. Twenty-seven percent (n = 194) of patients had been pronounced deceased. Fifty-eight percent (n = 419) of the patients who had an IVC filter placed were deemed eligible for filter retrieval per the stratification calculator. Initial rates of rIVCF removal in eligible patients were as low as 30-33%. After implementation of the clinical protocol, the retrieval rate of eligible filters rose to 44% from inception of the study in 2015 to September 2018, which was calculated following the data revisions discussed previously. Following the previously discussed protocol revisions, the overall rate of retrieval rose to 61% (n = 254) as of January 2021 (Figure 3). Table 1 offers an overview of filters placed and retrieved according to year of filter placement. The filters eligible for retrieval were accomplished at a 100% success rate.

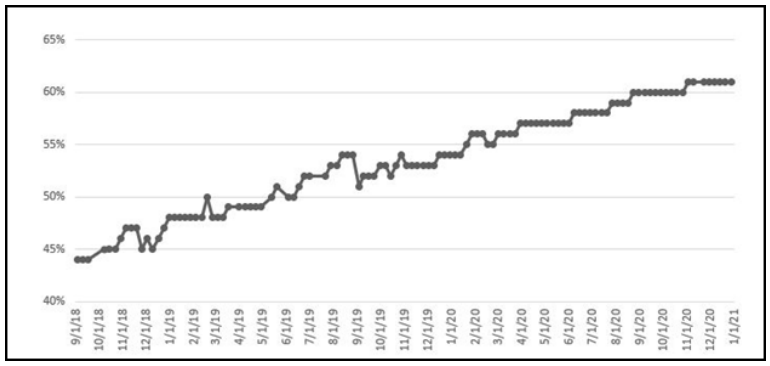

Figure 3. Percentage of eligible filters removed from 2015-2021. Data shown was acquired following the revisions made in 2018 to exclude patients requiring permanent filters and deceased patients.

DISCUSSION

This protocol highlighted the necessity of initiating communication with providers regarding implanted IVC filters. A small implant such as an IVC filter is easy to remain out of site and out of mind. Rates of removal of eligible IVC filters doubled, with rates initially 30-33% rising to 61% at the end of the study, which may be attributed to initiating regular communication with patients and their primary care providers.

Need for follow-up after IVC filter placement has been well established per the aforementioned risks with increased dwell time. With ever-increasing rIVCF placement across the U.S., health systems and providers need to have systems in place to ensure proper management and follow-up of patients.[1] IVC filters are accepted widely as a low morbidity method of preventing pulmonary embolism, though there was evidence that longer dwell times were associated with increased incidence of complications.[4] While removal of a chronically implanted filter is often complex, prolonged dwell times were not a contraindication to retrieval, as there were many reported cases of filters being removed safely using supplementary retrieval methods.[5,6] Study limitations included limited follow-up on patients who elected to receive care at an

Table 1. Overview of IVC filter retrieval rates.

	2015	2016	2017	2018	2019	2020	Totals	% of Total	Average
Total placed and reviewed for eligibility	159	130	118	144	133	35	719		120
Assigned permanent status after 90-day assessment	38	19	8	19	20	2	106	15%	18
Expired Patients	40	31	47	37	29	10	194	27%	32
Retrievable	81	80	63	88	84	23	419	58%	70
Retrieved	57	50	41	46	47	13	254	35%	42
% Retrieved/Retrievable	70%	63%	65%	52%	56%	57%	61%		60%

outside institution following rIVCF placement, as well as the initial use of paper letters for which delivery to intended recipients could not be guaranteed for reasons such as incorrect addresses or relocation. Electronic methods tend to reach the patient in a more efficient manor, as all appointments, procedures, and results are provided to the patient in the same manor. Additionally, use of Epic™ and myChart™ for communication in the latter half of the study may limit generalizability of results to institutions with similar EMR systems. A strength of the study was the availability to which a similar protocol may be applied at outside institutions, establishing a foundational protocol which can be customized for the individual institution to improve rates of eligible IVC filter retrieval, assuming no current protocols are in place.

In conclusion, employing a systemic protocol to aid in proper follow-up of patients following rIVCF placement can improve rates of retrieval in the appropriate clinical setting. Regular evaluation and revision of the process played a significant role in achieving a two-fold increase in preliminary retrieval rates. The percentage of retrievals will never be 100% due to multiple factors such as determined permanence, loss to follow up, and disease process. However, the direction of retrieval formats should be ever evolving with the common denominator being physicians will need to presume all accountability for appropriate retrieval per standardized guidelines. Processes have been put in place across the country to limit those patients who are not identified for retrieval and this study provided high yield markers to help throughout this process.

REFERENCES

[1] Karp J, Desai K, Salem R, Ryu R, Lewandowski R. A dedicated inferior vena cava filter service line: How to optimize your practice. Semin Intervent Radiol 2016; 33(2):105-108. PMID: 27247479.
[2] Sarosiek S, Crowther M, Sloan JM. Indications, complications, and management of inferior vena cava filters: The experience in 952 patients at an academic hospital with a level I trauma center. JAMA Intern Med 2013; 173(7):513-517. PMID:
[3] McLoney ED, Krishnasamy VP, Castle JC, Yang X, Guy G. Complications of Celect, Günther tulip, and Greenfield inferior vena cava filters on CT follow-up: A single-institution experience. J Vasc Interv Radiol 2013; 24(11):1723-1729. PMID: 24041915.
[4] Wang SL, Siddiqui A, Rosenthal E. Long-term complications of inferior vena cava filters. J Vasc Surg Venous Lymphat Disord 2017; 5(1):33-41. PMID: 27987607.
[5] Desai KR, Lewandowski RJ, Salem R, et al. Retrieval of inferior vena cava filters with prolonged dwell time: A single-center experience in 648 retrieval procedures. JAMA Intern Med 2015; 175(9):1572-1574. PMID: 26098535.
[6] Kuo WT, Tong RT, Hwang GL, et al. High-risk retrieval of adherent and chronically implanted IVC filters: Techniques for removal and management of thrombotic complications. J Vasc Interv Radiol 2009; 20(12):1548-1556. PMID: 19864160.

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