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Original Article

How Effective is a Departmental Registry Follow-up form for Improving Retrieval of Inferior Vena Cava Filters? A Single-center Experience

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Abstract

Purpose: This study evaluated the impact of a departmental registry follow-up form on the retrieval rate of retrievable inferior vena cava (IVC) filters. **Materials and Methods:** We performed a case–controlled retrospective study of all patients who had received such filters 2 years before and after the follow-up registry was implemented at the study center in June 2015. Patients were analyzed based on age, gender, indication, type of filter, date and location of filter insertion, date of retrieval, dwelling time, and previous attempts at retrieval. The two groups were compared in terms of filter type, rate of retrieval, and dwelling time, before and after the registry was implemented. **Results:** Between June 2013 and May 2017, 307 filters were inserted in 183 males and 124 females. Of these filters, 296 (96.42%) were placed below the renal veins and 11 (3.58%) were placed suprarenally. A total of 148 (48.21%) filters were inserted before implementing the follow-up form and 159 (51.79%) were inserted afterward. The retrieval rate was 35.81% before implementation of the registry form and 38.36% afterward. The mean dwelling time of retrieved filters prior to implementation was 32 days and 48 days during the 2 years after implementation, respectively. Filter retrieval was successful in 110 patients from the first attempt (96.49%) and four patients required more than one attempt (3.51%). **Conclusion:** The departmental vena cava filters' registry resulted in minimal improvement of retrievability rates. Younger age was associated with increased likelihood of retrieval. These data suggest that additional measures are required to further enhance retrieval rates.

Keywords: *Departmental registry, inferior vena cava filter, retrieval rates*

Introduction

Inferior vena cava (IVC) filters are designed with various durabilities and can be permanent or retrievable depending on the patient's condition.[1,2] Permanent filters were primarily used until retrievable filters were approved by the US Food and Drug Administration in 2003.[3] Although retrievable filters are designed to be removed, in some cases, they become permanent because of lack of patient compliance or poor monitoring.[4,5]

Evaluation of a US vena cava filters database, including nearly 55,000 IVC filter (IVCF) placement procedures, showed a gradual increase of retrieval rates between the years 2010 and 2014.[6] However, in 2014, the rates remained suboptimal at 24%, with weak correlation with the initiation of anticoagulation.[6] Another study that evaluated the nationwide Medicare Physician/Supplier Procedure Summary Master Files from 2012 to 2015 noted a steady decline in IVCF placement across all specialties and a gradual increase in retrieval rates to 14% by 2015.[7] Radiologists were responsible for 64% of IVCF placements and retrievals.[7] Similar findings were noted from Medicare claims data, which included more than 255,000 placement procedures between the years 2012 and 2016.[8] While retrieval rates are increasing, the annual net filter retrieval rate per filter placed remains as high as 22%.[8] Limited retrospective data from Saudi Arabia have indicated retrieval rates between 30% and 50% of retrievable filters.[9,10] However, nearly 60% of filters in this population were not retrieved because they were initially inserted as permanent devices, or patients required permanent filtration. In the Vascular and Interventional Radiology Department within our center, we established a departmental registry follow-up form in July 2015 to improve retrieval rates of IVCFs. The purpose of the present study was to compare retrieval rates

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before and after this form was implemented and to assess the need for any additional measures to improve the current retrieval rates.

Materials and Methods

Study design and setting

The study was designed as a pre–post analysis using STrengthening the Reporting of OBservational studies in Epidemiology guidelines. The study was approved by the Institutional Review Board and was conducted at the Radiology Department within our center in Riyadh, Saudi Arabia.

Study sample and inclusion and exclusion criteria

Between June 2013 and May 2017, 307 patients received IVCFs. The sample was divided into two groups: one comprising patients who had received their filters before the departmental registry follow-up form was implemented (from June 2013 to May 2015) and the other comprising patients who had received their filter after implementation of the departmental form (from June 2015 to May 2017). The form included the date of insertion, type of filter, primary physician contact details, and recommended date of follow-up. On the day of follow-up, the clinical coordinator at our unit contacts the primary team to inquire about the continued need for IVCF. Patients will be scheduled for removal when the filter is deemed no longer required. Otherwise, another follow-up reminder will be scheduled. The study included all consecutive adult patients (older than 18 years), of all nationalities and genders, who received a retrievable IVCF. No permanent filters were inserted during the entire study period.

Data collection

Data were extracted from the Radiology Information System and electronic medical records in July 2017. The data were later input into an Excel spreadsheet. The following variables were considered: age, gender, indication, type of filter, date and location of insertion, whether the IVCF was retrieved or not retrieved (main variable), date of removal, dwelling time, and previous attempts at retrieval. Since the study period spanned the transition between paper charts and electronic medical records, it was not possible to clearly identify why filters were not retrieved in each case. Therefore, patients whose filters were left permanently in place, or who died prior to removal, were considered as "not retrieved."

Statistical analysis

Categorical variables were expressed as percentages and calculated based on the number of patients who were eligible for retrieval. The retrieval rate was calculated as follows:

% retrieved = (IVCF retrieved/total IVCF inserted) × 100

Continuous variables were expressed as mean ± standard deviation (SD); all analyses were performed using Excel v. 15.41 (Microsoft Corp., Redmond, WA, USA).

Results

A total of 307 retrievable filters were inserted in 183 males (59.61%) and 124 females (40.39%), with a mean age of 59 years (SD = 17.24). Most filters were located infrarenally (96.42%), with a few located suprarenally. Five different types of filter were used, with the majority being "OptEase®" (*n* = 167; 54.40%). Table 1 summarizes the demographic characteristics of the patients included in this study, as well as the types and locations of the IVCFs they received.

A total of 148 (48.21%) filters were inserted before implementation of the follow-up form, with a retrieval rate of 35.81%. A total of 159 (51.79%) filters were inserted after implementation of the form, with a retrieval rate of 38.36%. Table 2 summarizes the reasons why the filters were placed, and Table 3 shows the types of filters that were placed, before and after implementation of the follow-up form.

The mean duration for which filters were left *in situ* ("dwelling time") prior to implementation of the follow-up form was 32 days (range: 4–215 days) and 48 days (range: 4–245 days) during the 2 years after implementation, respectively. This increase can be explained by the fact that filters with longer dwelling times were used. Filter retrieval was successful at the first attempt in 110 patients (96.49%), with four patients requiring

Table 1: Demographic characteristics of the patients included in this study and position and type of inferior vena cava filter received (*n*=307)

	***n* (%)**
Gender	
Male	183 (59.61)
Female	124 (40.39)
Age, mean±SD	59±17.24
Location	
Infrarenal	296 (96.42)
Suprarenal	11 (3.58)
Type of filter	
OptEase®	167 (54.40)
Denali®	78 (25.41)
Option Elite™	33 (10.75)
Celect	27 (8.79)
Capturex®	2 (0.65)

SD: Standard deviation

Table 2: Indications for filter insertion

Indication	**Preform, *n* (%)**	**Postform, *n* (%)**
Prophylactic	24 (16.22)	31 (19.5)
Venous thromboembolism with contraindication to anticoagulation	118 (79.73)	122 (76.73)
Unknown	6 (4.05)	6 (3.77)

more than one attempt (3.51%). Table 4 summarizes the filter retrieval rates, dwelling times, and previous retrieval attempts for patients in each group.

Age was found to be inversely proportional to retrieval rate [Table 5]. Among 183 males, 77 (42.08%) filters were removed. For females, 37 (29.84%) of 142 filters were retrieved. This yielded a male-to-female retrieval ratio of 1.4:1 [Table 6].

Discussion

To assess the effectiveness of our study, we compared our results with those of studies with the same aims. A study conducted at Boston Medical Center (BMC) between September 2003 and July 2013 reported that implementation of a multidisciplinary protocol increased retrieval rates.[11] The following four key elements were developed to improve the efficacy of this protocol: (1) patient educational pamphlets; (2) an additional IVCF procedure form; (3) a centralized interdepartmental IVCF registry; and (4) a dedicated administrative coordinator.[11] By contrast, our protocol included only two of these factors, and we lacked a detailed interdepartmental filter registry and educational pamphlets. The BMC protocol was coordinated by several departments,[11] whereas our study was confined to one department. Patients who died or who later were deemed to have had permanent filter insertion were excluded in the BMC study,[11] which may have spuriously increased their retrieval rate. Therefore, in our study, we considered such patients as "nonretrieved" to avoid falsely increasing the retrieval rates.

Our study also showed a change in the pattern of filter use over time. More OptEase® filters (Cordis, Milpitas, CA, USA) were used during the first 2 years of the study. This may have led to stricter adherence to retrieval recommendations by the referring services in order to avoid retrieval failure. Consequently, the dwelling time was shorter during this period. Conversely, more Denali® (Bard, Tempe, AZ, USA) and Option™ (Argon Medical, Frisco, TX, USA) filters were used during the 2 years after form implementation. This may have led to less strict adherence to retrieval recommendations and lower patient compliance. In addition, the dwelling time was longer during the last 2 years. These factors may explain the nearly equal retrieval rates despite implementation of the follow-up form by the coordinator of our unit.

The rate of retrieval was inversely proportional to age. This finding is consistent with findings by Brown *et al*., who reported that increasing age and some comorbidities were associated with lower retrieval rates.[6] The larger number of trauma patients in our cohort, and the lower number of comorbidities, may explain the higher rates of retrieval in younger patients. This is related to the ability to resume anticoagulation safely, rendering the need for permanent filtration less likely.

Table 3: Types of filters inserted before and after follow-up registry form implementation and the corresponding retrieval rates

	Preform (*n*)	Retrieval rate, *n* (%)	Postform (*n*)	Retrieval rate, *n* (%)
OptEase®	120	48 (40)	47	16 (34)
Celect	26	4 (15)	1	0
Option Elite™	1	0	32	8 (25)
Denali®	1	1 (100)	77	35 (45)
Capturex	0	0	2	2 (100)

Table 4: Filter retrieval rate, dwelling time, and previous attempts of retrieval

	Filter retrieved		Mean dwelling time (days)
	Yes (%)	No (%)	
Before implementation of the form (*n*=148)	53 (35.81)	95 (64.19)	32
After implementation of the form (*n*=159)	61 (38.36)	98 (61.64)	48
	First attempt, *n* (%)		More than one attempt, *n* (%)
Previous retrieval attempts	110 (96.49)		4 (3.51)

Table 5: Filter retrieval rates according to age

Age (years)	Retrieval rate (%)
18-30	65
31-50	58.12
51-70	22.97
>70	15.15

Table 6: Filter retrieval according to gender

Gender	Retrieved filters, *n* (%)
Male (*n*=183)	77 (42.08)
Female (*n*=124)	37 (29.84)

Our study was limited by its retrospective nature and the relatively small number of patients from a single center. There was 3-month interruption in elective admissions between August 2015 and October 2015 because of an in-hospital outbreak of Middle East respiratory syndrome-coronavirus, which may have falsely increased the dwelling time in the postform period. In addition, IVCF placement is often requested by various medical and surgical specialties and proper documentation for the continued need of filter was lacking in majority of cases. Neither data related to resumption of anticoagulation nor the reasons for nonretrieval could be accurately identified because of the transition from paper charts to electronic medical records in early 2016. Therefore, for the purpose of this study, we considered all filters are placed with an intention to retrieve. Nevertheless, the present study provides insight into the current practice in one of the largest institutions in our region. The retrieval rates in our

institution were comparable to those reported in the US and European centers.[6,8,12,13]

Although there was a slight increase in retrieval rates, this survey indicates the need for additional measures to improve interdepartmental collaboration to further increase retrieval rates and prevent long-term complications of IVCFs.

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Conflicts of interest

There are no conflicts of interest.

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