

Trends in inferior vena cava filter placement and retrieval at a tertiary care institution



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ABSTRACT

Objective: The aim of this study was to examine practice patterns of inferior vena cava (IVC) filter insertion and retrieval at a tertiary care institution.

Methods: A retrospective review of all IVC filter procedures performed at the University of Pennsylvania and entered into the Penn cohort of the Vascular Quality Initiative registry between January 2013 and September 2017 was performed. Data collected included demographics, venous thromboembolism risk factors, indications for filter placement, and presence and timing of retrieval. Trend analysis and multivariable logistic regression were performed to evaluate factors associated with failure to retrieve the filter.

Results: During the study period, 627 IVC filters were inserted. The mean age was 52.8 ± 16.9 years, and 49.3% were male; 39.2% were placed for a major indication, whereas 58.1% were placed for prophylaxis. There was a significant decline in overall frequency of filter placement during the period observed, with a 33% decrease from 2015 to 2016 and a 26% decrease from 2016 to 2017 ($P < .001$), with an overall retrieval rate of 44.9%. In contrast, there was a corresponding increase in filter retrieval, with a 20% increase in 2015 and a 68% increase in 2016 ($P = .02$). In evaluating trends separated by indication, there was a significant decline in prophylactic filter placement ($P < .001$) and a trend toward an increase in retrieval of prophylactic filters ($P = .09$). Whereas there was not a significant change in number of filter insertions for major indication ($P = .06$), filter retrievals for major indication filters increased ($P = .01$). Multivariable regression analysis revealed that longer time to follow-up (odds ratio [OR], 1.08; $P < .001$) and discharge to rehabilitation facility (OR, 6.14; $P < .001$) were predictive of failure to retrieve the filter. In contrast, filter placement at a later date within our study period (OR, 0.90; $P < .001$) and prophylactic indication for filter placement (OR, 0.36; $P < .001$) were protective from filter nonretrieval.

Conclusions: These results show both a decline in overall IVC filter placement and an increase in overall IVC filter retrieval at our institution. These trends are predominantly due to a decrease in prophylactic filter placement as well as an overall increase in filter retrieval. Further study should be dedicated to increasing the retrieval rate in this population of patients. (J Vasc Surg: Venous and Lym Dis 2019;7:405-12.)

Keywords: Vena cava filters; Venous thromboembolism; Inferior vena cava; Vena cava filter trends

Venous thromboembolism (VTE) is a leading cause of morbidity and mortality in the United States, occurring at a rate of 1 in 1000 in the general population.¹ VTE is the leading cause of preventable in-hospital mortality and accounts for 300,000 deaths annually in the United States.² Inferior vena cava (IVC) filters, first introduced in 1973 by Greenfield et al,³ were designed to offset this

mortality by preventing pulmonary embolism (PE). Technologic advances in the early 2000s led to the development of retrievable IVC filters, first approved by the Food and Drug Administration (FDA) in 2003.⁴ The combination of retrievable filter design with smaller diameter percutaneous access platforms resulted in a dramatic increase in IVC filter placements in the 2000s.⁵ Parallel to this growth in filter placement was an expansion of indication for filter placement, including that for the purpose of prophylaxis and relative (minor contraindication to anticoagulation) indications.⁶

The major proposed benefit of the retrievable design was to avoid the long-term complications associated with permanent filters.^{7,8} However, overall retrieval rates remained low, ranging from 12% to 45%.⁹ With more filters in place for longer times, an increase in filter-related complications was observed,¹⁰ prompting the FDA to issue an advisory in 2010 and again in 2014 urging removal of IVC filters as soon as protection from PE is no longer required.^{11,12}

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In the early 2010s, after the initial FDA warning and after the 2012 Medicare reimbursement changes that lowered reimbursement for IVC filter placement, there was a significant decline in IVC filter placement as shown in multiple national data sets.¹³⁻¹⁶ However, because of lack of granularity in national data sets, it remains unknown what subset of filters are no longer being placed. Furthermore, owing to difficulties with proper coding and billing for IVC filter retrieval, national data sets have not been able to accurately assess trends in filter retrieval rates during the past decade.

In this study, we investigated practice patterns of IVC filter insertion and retrieval at a tertiary care institution. The granular data afforded the opportunity to investigate trends in filter placement and retrieval, delineated by indication, during the past half-decade.

METHODS

Data sources and study population. A retrospective review of all IVC filter procedures entered into our institutional Vascular Quality Initiative (VQI) IVC registry module between January 2013 and September 2017 was performed. Data collected included demographics, VTE risk factors, indications for filter placement, filter complications, and presence and timing of retrieval. To be entered into our VQI database, patients had to have the filters placed within our health system. Those filters that were retrieved within our health system but originally placed at an outside hospital were not included in this analysis. Furthermore, those filters that were placed at an outside hospital but then retrieved within our health system were not included in this analysis. Corresponding retrieval data were collected as part of the standard follow-up form for the IVC filter module.

The study was reviewed by the University of Pennsylvania Institutional Review Board, met the requirements for exemption from review, and qualified for waiver of informed consent.

Definitions: Indications for filter placement and proportion of filter retrievals. Indication for filter placement has been categorized into one of three possible groups: major indication, relative indication, and prophylactic indication.⁶ Major indication filters were placed in patients with both VTE and one of the following conditions: contraindication to anticoagulation, inability to maintain therapeutic levels of anticoagulation, and recurrent VTE on anticoagulation. Relative indication filters were placed in patients with VTE who did not meet major indications for filter placement but had one of the following characteristics that placed them at high risk for PE or for decompensation if PE were to occur: free-floating thrombus, noncompliance with anticoagulation regimen, massive PE burden, iliofemoral deep venous thrombosis (DVT), or malignant disease. Prophylactic filters were placed in those patients without

ARTICLE HIGHLIGHTS

- **Type of Research:** Single-center retrospective case-control study
- **Key Findings:** Of the 627 inferior vena cava filters that were placed from 2013 to 2017 at our institution, 44.9% were retrieved. However, the rates of filter retrieval dramatically increased, with 22.7% of filters retrieved in 2013 and 81.7% of filters retrieved in 2016.
- **Take Home Message:** The authors show a changing clinical practice pattern with a decline in overall filter placements (predominantly in prophylactic filters) and an increase in overall filter retrievals. These data reflect an evolving clinical environment marked by more conservative filter insertion and more aggressive filter retrieval and follow-up.

VTE but who were deemed at high risk for development of VTE, including major planned surgical procedures and recent trauma.

Because the majority of filters placed in this study were for major or prophylactic indications (>97%), analysis of trends and multivariable analysis were limited to those patients receiving filters for major or prophylactic indication. The proportion of filters retrieved was defined on the basis of quarterly analysis. In any particular quarter, the total number of filters retrieved divided by total number of filters placed generated the proportion of filters retrieved. Although this designation affords the possibility of retrieval proportions being >100% in any given quarter, it allowed the most descriptive and informative analysis of trends over time in filter retrieval and placement. Quarterly time points were chosen for analysis over half-year delineations to ensure sufficient data points to accurately and precisely evaluate trends over time.

Statistical analysis. Trend analysis was performed with linear regression after verifying model assumptions for linearity using residual plots checking for normal distribution, homoscedasticity, and independence. Univariable and multivariable logistic regression analyses were performed to determine predictors of retrieval failure. All variables that were significant on univariable analysis were included in the multivariable analysis. All *P* values <.05 were considered statistically significant. Statistical analyses were performed using Stata 14.2 statistical software (StataCorp, College Station, Tex).

RESULTS

Patients' demographics and clinical characteristics. There were 627 patients who had IVC filters placed from January 2013 through September 2017. Demographics and baseline medical comorbidities of these patients

Table I. Patients' demographics and preoperative medical characteristics

Patients' demographics and medical comorbidities (N = 627)	% or mean \pm SD
Age, years	52.8 \pm 16.9
Male sex	49.3
BMI, kg/m ²	41.1 \pm 17
Medical comorbidities	
CAD	7.2
CHF	10.9
COPD	24.2
Diabetes	29.7
Dialysis	2.9
History of VTE	14.5
HTN	64.1
Lower extremity DVT	29.8
Malignant disease	24.6
PE	18.7
Thrombophilic state	1.9
Filter manufacturer	
Bard	5.6
Cook	94.4

BMI, Body mass index; *CAD*, coronary artery disease; *CHF*, congestive heart failure; *COPD*, chronic obstructive pulmonary disease; *DVT*, deep venous thrombosis; *HTN*, hypertension; *PE*, pulmonary embolism; *SD*, standard deviation; *VTE*, venous thromboembolism.

are summarized in Table I. Average age was 52.8 years, and 49.3% were male. Approximately 15% of patients had a previous history of VTE. At the time of filter placement, 29.8% of patients had lower extremity DVT, and 18.7% of patients had PE. The majority of filters placed in the study were produced by Cook (94.4%), and all filters were retrievable.

Indications for filter placement. The majority of filters placed during our study period were for prophylaxis (58.1%), followed closely by major indication (39.2%). Only 2.7% of filters were placed for relative indications. Indication data are summarized in Table II. For prophylactic indication filters, the majority were placed for patients planning to undergo a major surgical procedure. Bariatric operations accounted for 63.2% of the planned procedures group; the remaining procedures included chest or abdominal surgery (14.6%), orthopedic surgery (8.5%), neurosurgery (3.0%), and other surgery (8.5%). For major indication filters, the majority of patients had a contraindication to anticoagulation.

Filter follow-up and retrieval data. We were able to contact 79.1% of all patients included in our study for follow-up analysis by completion of the IVC filter follow-up form. Follow-up data are summarized in Table III. Mean time to follow-up survey was 9.6 months. Filter

Table II. Inferior vena cava (IVC) filter insertion indications

Indication for placement (N = 627)	%
Major indication (n = 246)	
Contraindication to anticoagulation	35.3
Recurrent VTE on anticoagulation	2.6
Unable to maintain therapeutic anticoagulation levels	2.4
Relative indication (n = 17)	
Free-floating thrombus	0
Iliofemoral DVT	9.7
Massive PE	4.8
Noncompliant with anticoagulation regimen	0
Prophylactic indication (n = 364)	
Major procedure planned	56.8
Recent trauma	4.3

DVT, Deep venous thrombosis; *PE*, pulmonary embolism; *VTE*, venous thromboembolism.

retrieval rate was 44.9%. Of those patients we were able to contact for follow-up, 56.8% had filters retrieved. Of the filters that were not retrieved, the majority were due to patients' declining the retrieval procedure (69.1%), followed by the filter's being deemed present too long for safe retrieval by the vascular surgeon (25.7%). Technical success of filter retrieval was achieved in 98.4% of retrieval attempts. Mean time to filter retrieval was 4.6 months (standard deviation, \pm 4.3 months). Overall, 2.1% of patients had complications associated with filter placement (n = 3 IVC filter strut perforation, n = 8 IVC/filter thrombosis, n = 2 access site thrombosis). After filter placement, 20.3% of patients were discharged to a facility. Only one patient had a filter retrieval complication (bleeding from right internal jugular access site).

Trends in filter placement and retrieval. Overall trends in filter placement and retrieval are summarized in Fig 1. From 2013 to 2017, there was a significant and steady decline in overall filter placements ($P < .001$). This cumulative, yearly decline was most pronounced in the final 2 years of our study: a 33% decrease from 2015 to 2016 and a 26% decrease from 2016 to 2017. On the contrary, there was a significant increase in overall filter retrievals from 2013 to 2016 ($P = .02$). Whereas filter retrieval rates remained relatively stable from 2013 to 2014, there was a significant increase in filter retrievals starting in 2015 ($P = .02$): a 20% increase in 2015 and a 68% increase in 2016. With overall filter placements decreasing and retrievals increasing, the proportion of filters retrieved dramatically increased in the years of our study from 22.7% in 2013 to 81.7% in 2016.

Further analysis focused on understanding differences in filter placement and retrieval delineated by indication. Fig 2 shows a clear change in filter insertion practice with a dramatic decrease in the proportion of filters placed for

Table III. Follow-up data and filter complication data

Follow-up and complications	% or mean ± SD
Time to contact, months	9.6 ± 7.3
Able to be contacted	79.1
Retrieval rate of those contacted	56.8
Retrieval rate overall	44.9
Retrieval success rate	98.4
Time to filter retrieval, months	4.6 ± 4.3
Receiving anticoagulation at time of follow-up	24.9
New DVT at follow-up	4.7
New PE at follow-up	0.9
Discharged to facility	20.3
Filter complications	
IVC filter strut penetration	0.4
IVC/filter thrombosis	1.3
Access site thrombosis	0.3

DVT, Deep venous thrombosis; IVC, inferior vena cava; PE, pulmonary embolism; VTE, venous thromboembolism.

prophylactic indication ($P < .001$), with a subsequent increase in filters placed for major indication ($P = .03$). Beginning in 2017, more filters were being placed for major rather than for prophylactic indication.

Overall trends in filter placement and retrieval for major indication are summarized in Fig 3. There was not a significant change in number of filter placements for major indication ($P = .06$). However, filter retrievals for major indication increased ($P = .01$), as did the proportion of filter retrievals ($P < .001$). Indeed, the proportion of major indication filters retrieved increased from 3.5% in 2013 to 41.6% in 2016.

Overall trends in filter placement and retrieval for prophylactic indication are summarized in Fig 4. There

was a dramatic and significant decline in prophylactic filter placements from 2013 to 2017 ($P < .001$). During the 4 years of the study, there was a >50% decline in IVC filter placement. There was a trend toward an increase in retrieval of prophylactic filters ($P = .09$) as well as a significant increase in the proportion of prophylactic filters retrieved ($P = .02$). Notably, the proportion of prophylactic indication retrievals increased from 35.6% in 2013 to 125.0% in 2016.

Predictors of filter nonretrieval. Selected variables were chosen for univariable analysis to predict failure of filter retrieval. These variables included age, date of surgery, sex, race, body mass index, primary insurer type, hypertension, diabetes, coronary artery disease, congestive heart failure, chronic obstructive pulmonary disease, preoperative dialysis, indication for filter placement (major or prophylactic filter indication), recent trauma, discharge destination, major planned procedure, pulmonary emboli, lower extremity DVT, smoking, malignant disease, creatinine level, new DVT after filter placement, new PE after filter placement, taking an anticoagulant at time of follow-up, filter device manufacturer, filter complications, and time to follow-up. Only those variables that were significant from the univariable analysis were included in the multivariable regression analysis. Significant results of the regression analysis are summarized in Table IV. Two variables were found to be predictive of failure to retrieve the filter: longer time to follow-up (odds ratio [OR], 1.08; $P < .001$) and discharge to facility (OR, 6.14; $P < .001$). In contrast, the two variables that were found to be protective from filter nonretrieval were filter placement at a later date within our study period (OR, 0.9; $P < .001$) and prophylactic indication for filter placement (OR, 0.36; $P < .001$).

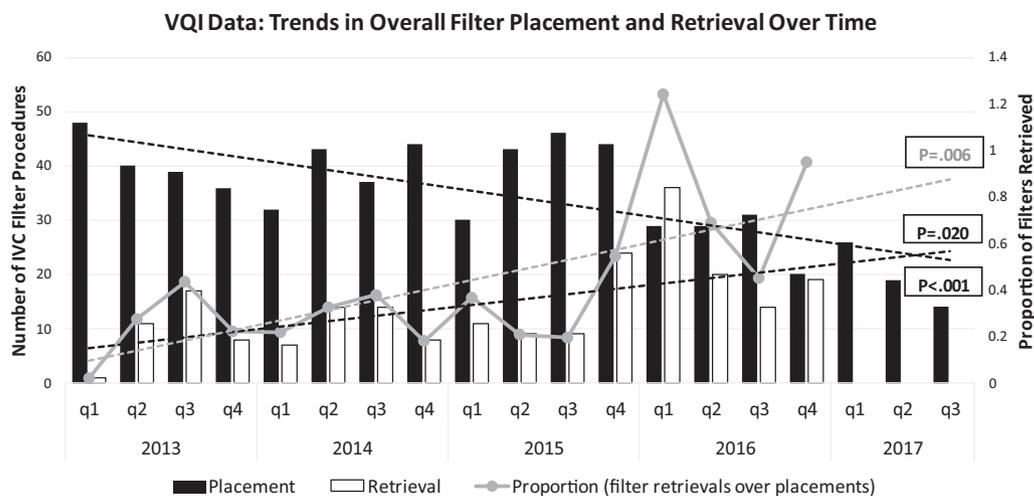


Fig 1. Trends in overall inferior vena cava (IVC) filter placement and retrieval over time. The proportion of filters retrieved is generated from number of filters placed over number of filters retrieved in each quarter year. The dotted lines indicate linear regression line of best fit for each group.

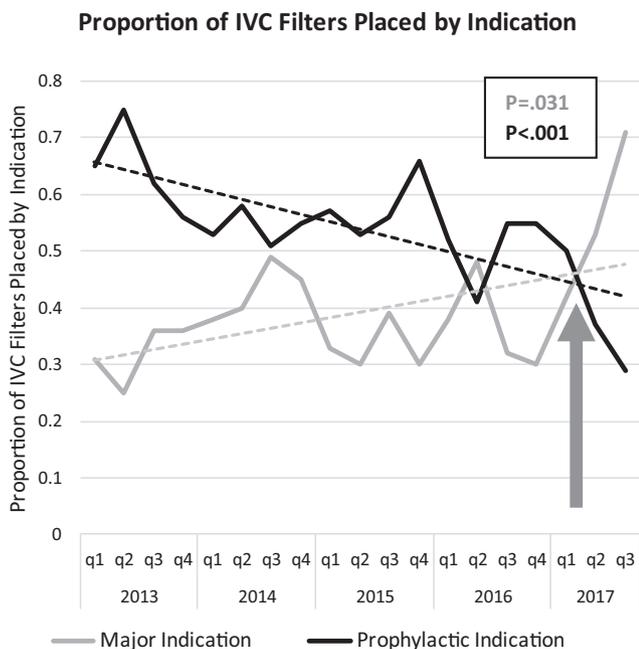


Fig 2. Proportion of inferior vena cava (IVC) filters placed for major and prophylactic indications over time. The dotted lines indicate linear regression line of best fit for each group.

DISCUSSION

After the 2010 FDA warning¹² urging filter retrieval as soon as risk of PE had diminished, the number of IVC filter placements dropped across the entire country. This finding has been verified in publications using institutional,¹⁵ statewide,¹⁷ and national¹³⁻¹⁵ data sets. Although this trend is well documented, specific information on which clinically indicated filters are no longer

being placed has been lacking. National and statewide data sets lack the necessary granular details to ascertain this information. Furthermore, because of changes in *International Classification of Diseases, Ninth Revision* (ICD-9) and *Current Procedural Terminology* (CPT) codes for filter retrieval, both institutional and national databases have not been able to accurately analyze filter retrieval data. Before the 2015 update to the *International Classification of Diseases, Tenth Revision*, there was no ICD-9 code specific for filter retrieval. Furthermore, before the changes to CPT coding in 2012, there was no reliable way to document filter retrieval. It was only after the 2012 CPT changes that an accurate means for reporting retrieval became available.

Our institutional study used the data from the IVC filter module of the VQI to obtain the necessary granular details to further characterize trends in filter placement and retrieval. Similar to the national data sets, our study demonstrates a significant decrease in IVC filter placements: a 33% decrease from 2015 to 2016 and a 26% decrease from 2016 to 2017. The majority of this decline was due to a dramatic decrease in filters placed for prophylactic indications. Less than 3% of all filters were placed for relative indications, and thus no trends could be statistically substantiated. The rates of filter placement for major indications remained relatively stable. This move away from filter placement for prophylactic indications is not surprising and is a reflection of a unique change in practice at our institution. However, before this study, various single-institution studies documented a clear trend toward an increase in relative and prophylactic filter placement.¹⁸⁻²⁰ The impetus for our institution's shift away from placing prophylactic and relative indication filters is likely twofold. First, after conferring with our

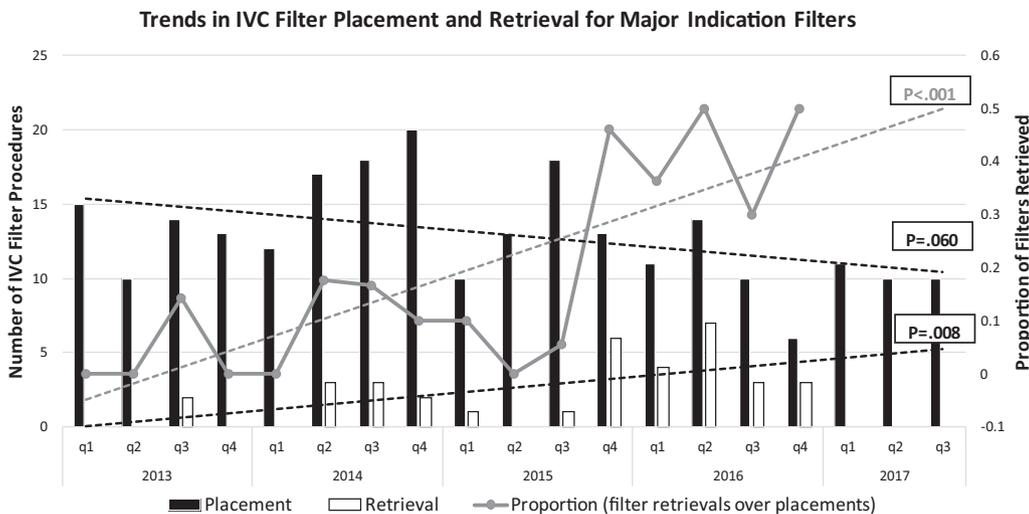


Fig 3. Trends in placement and retrieval for major indication inferior vena cava (IVC) filters over time. The proportion of filters retrieved is generated from number of filters placed over number of filters retrieved in each quarter year. The dotted lines indicate linear regression line of best fit for each group.

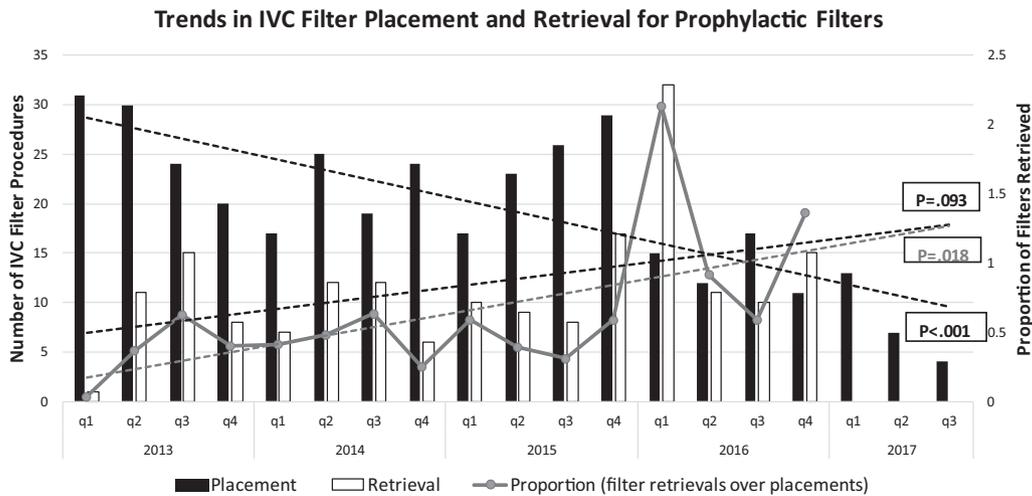


Fig 4. Trends in placement and retrieval for prophylactic indication inferior vena cava (IVC) filters over time. The proportion of filters retrieved is generated from number of filters placed over number of filters retrieved in each quarter year. The dotted lines indicate linear regression line of best fit for each group.

bariatric surgeon colleagues, we have made a concerted effort to decrease prophylactic filter placement in this population of patients. Second, our practice patterns as a whole have shifted to become more conservative in placing filters after the adjusted 2016 CHEST guidelines, which list Grade 1B level of evidence for not placing filters in patients who are able to be treated with anticoagulation.²¹ Furthermore, the updated CHEST guidelines also suggest changing to low-molecular-weight heparin for patients who have recurrent DVT while receiving anticoagulation, rather than offering filter placement (Grade 2C).²¹

Rates of filter retrieval have been less substantiated at a national data set level largely because of inaccuracies associated with ICD-9 and CPT coding. A systematic analysis of single-institution studies estimated national retrieval rates at 12% to 45%, with a mean rate of 34%.⁹ In our study, overall retrieval rates were 44.9%. However, we did observe a significant increase in filter retrieval rates through the course of the study, 22.7% in 2013 to 81.7% in 2016 ($P < .001$). This trend was also observed in both the major and prophylactic indication populations: retrieval rates for major indication filters increased from 3.5% in 2013 to 41.6% in 2016; retrieval rates for prophylactic indication filters increased from 35.6% in 2013 to

125.0% in 2016. The reason for this increase in filter retrieval proportion through the course of our study is likely multifactorial. First, through the course of the study, our department has embarked on a more robust and protocolized follow-up program for IVC filter patients. Our surveillance program consists of a few key components. The process starts with our surgical consenting, whereby we have a lengthy discussion with the patient and family about the expectations for how long the filters should be left in place. We reiterate the information of this discussion in the discharge paperwork when it becomes time for the patient to leave the hospital. Regardless of the expected duration of the filter, we routinely schedule patients to see them in clinic about 30 days after filter placement to have a discussion about device retrieval. Furthermore, based on certain patient factors, we will schedule some filters to be retrieved sooner than 30 days. We also have methods to follow up with those patients who do not return for the 30-day clinic visit. Our IVC filter patients are entered into the VQI filter registry. The analytics tool of the database enables the generation of a list of patients who have yet to follow up. After a certain period of time with no follow-up, we check the VQI analytic tool to determine which patients have not returned to clinic. We then will reach out to those patients with a phone call and schedule for them to follow up and discuss filter retrieval. Many of these efforts have been shown to increase filter retrieval rates at other institutions.²²⁻²⁴

Second, patients are now more informed of the complications of IVC filters left in place for longer times and are now more likely to seek follow-up for retrieval of the filters. A contributing factor to this heightened patient awareness has likely been the increased attention placed on IVC filters in social media and advertisements as a result of recent litigation.²⁵ Two large multidistrict

Table IV. Predictors of failure to retrieve inferior vena cava (IVC) filter in multivariable regression analysis

Variable	OR (95% CI)	P value
Later surgery date	0.90 (0.85-0.95)	<.001
Prophylactic indication (vs major)	0.36 (0.20-0.68)	<.001
Time elapsed between filter insertion and follow-up	1.08 (1.03-1.12)	<.001
Discharge to facility	6.14 (3.01-12.50)	<.001

CI, Confidence interval; OR, odds ratio.

litigation trials against Cook and Bard each began recruiting patient cases in late 2014. Significant advertisement campaigns led to an increase in cases included in these multidistrict litigation trials.²⁵ Mirroring this increased litigation activity and lawyer advertisements was an increase in the Google search term “IVC filter lawsuit.” A Google trend analysis of that term showed an exponential increase from 100 searches in 2012 to 10,000 in 2015.²⁵ Our data indicate that the largest jump in retrieval rates and proportion retrieval rates occurred in late 2015 and early 2016, right at the peak of this increased media attention.

To better understand why some filters were not being retrieved, we performed a multivariable logistic regression analysis to determine the predictors of filter nonretrieval. Similar to other studies, we found that discharge to facility predicted nonretrieval and prophylactic indication predicted retrieval.^{18,26} Unlike other studies, we did not find that age, sex, or any other baseline medical comorbidities predicted nonretrieval.^{18,26} Interestingly, we did find that those patients who had filters placed at a later date (further along in our study) were more likely to have the filters retrieved. This finding corroborates our division's increased outreach and follow-up programs for IVC filter patients.

The decrease in IVC filter placement and increase in IVC filter retrieval did not lead to an increase in institution-wide PE rates during the years of our study. Using diagnosis codes from our institution's inpatient billing data, we found that in-hospital PE rates decreased from 0.23% in 2013 to 0.09% in 2017 ($P = .011$). Interestingly, DVT rates also decreased from 0.28% in 2013 to 0.09% in 2017 ($P = .027$). Whereas the decreasing rate of PE may initially seem counterintuitive, the literature would suggest otherwise. Studies have shown a lack of reduction in PE rates in patients receiving IVC filters for prophylactic indications; the decline in filter placements and increase in retrievals in our study occurred predominantly in this prophylactic filter group (patients with major planned procedures and trauma patients). A meta-analysis of >270,000 trauma patients with IVC filters (93% placed prophylactically) found no change in incidence of PE from 2003 to 2015 despite decreased use of IVC filter placement throughout the years of our study.²⁷ A similarly designed study found that trauma patients with IVC filters had no reduction in mortality but did have higher DVT rates.²⁸ Further questioning the utility of prophylactic IVC filters was a study that evaluated mortality benefits of IVC filters in trauma patients at a major trauma center from 2003 to 2012; the investigators found no survival benefit in those patients who received filter placement.²⁹ Furthermore, those patients had only an 8% retrieval rate, increasing the likelihood for development of filter complications subsequently. Although there are small anecdotal studies that suggest a possible benefit of IVC filter prophylaxis in certain

high-risk bariatric surgery, orthopedic surgery, or other surgical patients, there is no high-quality, large-sample study showing a proven PE rate reduction or mortality benefit in these groups of patients. Other institution-wide initiatives, such as adherence to VTE prophylaxis with subcutaneous heparin, as well as trends toward earlier mobilization of surgical patients may also contribute to this positive trend in decreasing PE rates.

Limitations. As with any retrospective review, a limitation of this study is that there may be unknown confounding variables. The VQI, however, does contain a large number of variables that are inclusive of most influential factors. As a single-institution study, our results may not be generalizable to the national population. Because of the manner in which patients were included in our study (registered through VQI data entry), our data are likely to underestimate actual retrieval rates. Those filters placed at our institution but retrieved at an outside facility were not able to be identified as retrieved filters in our data set. We also did not analyze those filters that were retrieved by Penn vascular surgeons but placed at other hospitals. Furthermore, we did not collect data of patients who were considered for filter placement but did not eventually receive the filter because of the patient's refusal, the physician's preference, or any other reasons. Another limitation of this study is the lack of thorough representation of patient-specific data. Although our institution's VQI IVC filter database offered us the opportunity to investigate patient-specific trends in filter retrieval timing, we chose to represent retrieval rates in quarterly time points. Although this depicted filter retrievals that were not patient specific (retrievals were often performed on filters placed in different quarters), it did afford the best depiction of trends in filter placement and retrieval over time, the major theme of this manuscript.

CONCLUSIONS

This retrospective, single-institution study of 627 patients undergoing IVC filter placement from January 2013 through September 2017 shows both a decline in overall IVC filter placement and an increase in overall IVC filter retrieval. These trends are predominantly due to a decrease in prophylactic filter placement as well as an overall increase in filter retrieval for all indications. These trends underscore a changing clinical environment at our institution, with more conservative filter placements and more aggressive filter retrieval and follow-up. Further study should be dedicated to increasing the retrieval rate in this population of patients.

AUTHOR CONTRIBUTIONS

Conception and design: NB, GW

Analysis and interpretation: NB, BJ, PF, SD, VK, MG, RF, GW

Data collection: NB, GW

Writing the article: NB, GW

Critical revision of the article: NB, BJ, PF, SD, VK, MG, RF, GW

Final approval of the article: NB, BJ, PF, SD, VK, MG, RF, GW

Statistical analysis: NB, GW

Obtained funding: Not applicable

Overall responsibility: NB

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