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Penetration of the inferior vena cava and adjacent organs after filter placement is associated with retrievable filter type and length of time in place

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Objective: **Concern over local complications of inferior vena cava (IVC) filters exists, but little long-term data are available. Referrals for filter penetrations on computed tomography (CT) have increased with no standards for management. We reviewed postfilter CT findings in our institution.**
Methods: **All patients receiving IVC filters between January 1, 2006 and December 31, 2009 with a postfilter CT were reviewed. Penetration was graded with a previously published scale. Filter indication, type, and subsequent encounters for abdominal or back pain were recorded.**
Results: **A total of 591 patients had a filter during the study period. Of these, 262 had an adequate postfilter CT, comprising the study group. Indications were prophylaxis in 16.4% and venous thromboembolism in 83.6%. Of filters placed for venous thromboembolism, indications were absolute (inability/failure of anticoagulation) in 44.7% and relative in 55.3%. Retrievable filters made up 92.7% of the filters, and 7.3% were permanent type. Of the retrievable filters, 1.6% were retrieved. One hundred twenty (45.8%) filters had grade 2 or 3 penetration. Another 38.2% (100) had struts immediately adjacent to the external aspect of the IVC, which may represent tenting of the cava. Grade 2 or 3 penetration occurred in 49.0% of retrievable filters but only 5.3% of permanent filters ($P = .0001$). Grade 2 or 3 penetration occurred in 18.2% of filters less than 30 days old but in 57.3% of filters 30 days old or older ($P < .0001$). Thirty-two patients had subsequent encounters for abdominal or back pain, but none was conclusively related to penetration.**
Conclusions: **A majority of filters were placed for prophylaxis or relative indications and were retrievable type. Retrieval rate was low. Penetration of the IVC and adjacent organs was common and associated with retrievable type and length of time in place. It is unclear if most penetrations cause problems. Monitoring of penetrations with CT may be important to understand the natural history of this condition. (J Vasc Surg: Venous and Lym Dis 2014;2:174-8.)**

Over the last decade, inferior vena cava (IVC) filter placement has increased significantly, despite a lack of evidence supporting expanded use.[1] Robust data from the Prévention du Risque d'Embolie Pulmonaire par Interruption Cave (PREPIC) trial,[2] prior to the era of retrievable filters, supports the use of filters to decrease the incidence of pulmonary embolus (PE). However, it remains unclear if more recent iterations of the IVC filter represent an improvement that translates into superior clinical outcomes. Indeed, as reports of complications of newer-generation filters gain publicity, there is increasing pressure to reexamine trends in use and outcomes of IVC filtration.

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At our institution, we noted a significant increase in referrals for complications of IVC filters, most commonly strut penetrations identified on imaging. No guidelines for management of these penetrations exist, and treatment heretofore has been left to the judgment of the individual practitioner. We sought to inform treatment by describing the natural history of IVC filter strut penetrations as seen in postfilter placement computed tomography (CT) scans.

METHODS

A retrospective review of all patients receiving an IVC filter at our institution between January 1, 2006 and December 31, 2009 was performed. All of those who also had a subsequent CT scan imaging the entirety of the filter were included in the study population. Patients without a postfilter CT scan were not included.

Each CT scan was reviewed by a single individual (M.G.) with specific attention to strut penetration. Degree of penetration was graded with a previously published scale (Table I; Fig 1).[3]

Filter indication, type, and subsequent encounters for abdominal or back pain were recorded. χ^2 testing was used on contingency tables with large cell values, and Fisher exact testing was used on contingency tables with small cell values.

The conduct of this study was approved by The Ohio State University Institutional Review Board.

Table I. Grading system for degree of penetration 3

CT finding	*Grade*
Struts confined entirely within IVC	0
Strut immediately adjacent to external aspect of IVC wall ("tenting")	1
Strut entirely outside IVC lumen ("halo" of retroperitoneal fat around strut)	2
Strut interacts with aorta, duodenum, or other organs	3

CT, Computed tomography; *IVC,* inferior vena cava.

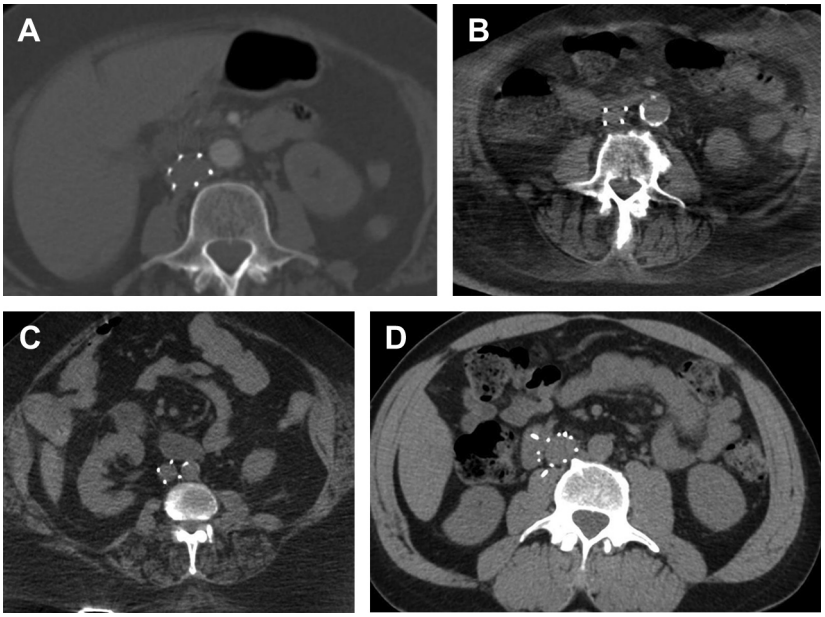

Fig 1. Examples of grades of penetration. **A,** Grade 0. **B,** Grade 1. **C,** Grade 2. **D,** Grade 3.

RESULTS

Five hundred ninety-one patients had a filter placed at our institution during the study period. Of these, 262 had an adequate postfilter CT scan, comprising the study group. Males comprised 51.5% of the study group. The ethnicity of the group was made up of 57.6% Caucasian, 23.0% African American, and 19.4% of other ethnicity. The average age was 59 years. In terms of placement, 19.5% of filters were placed by vascular surgeons, 79.8% were placed by interventional radiologists, and 0.7% were placed by general surgeons.

Indications for filter placement were PE prophylaxis in 16.4% and treatment of diagnosed venous thromboembolism in 83.6%. Of filters placed for a diagnosed venous thromboembolism, indications were absolute (an inability to or failure of anticoagulation) in 44.7% and relative in 55.3%. Relative indications included massive PE or low pulmonary reserve, clinically severe obesity, paraplegia, metastatic cancer, and unknown (Table II).

A total of 92.7% of filters were retrievable, and 7.3% were permanent. Distribution of filter type is shown in Table III. As of January 2013, 1.6% of retrievable filters were retrieved. The mean time from filter placement to CT scan was 406 days.

One hundred twenty (45.8%) filters had grade 2 or 3 penetration (Table IV). A total of 4.6% (12) had aortic penetration, 9.9% (26) had duodenal penetration, and 2.3% (6) had spine, colon, or kidney penetration; seven patients had simultaneous penetration of two organs. Another 38.2% (100) had struts immediately adjacent to the external aspect of the IVC, which may represent "tenting of the cava."

Grade 2 or 3 penetration occurred in 74.4% of Celect (Cook Medical, Bloomington, Ind) filters, 44.6% of Tulip (Cook Medical) filters, 5.3% of Greenfield (Boston Scientific, Natick, Mass) filters, and 0% of Optease (Cordis, Bridgewater, NJ) filters ($P = .0000$). Grade 2 or 3 penetration occurred in 49.0% of retrievable filters but only 5.3% of permanent filters ($P = .0001$). There was a trend toward association of uniconical filters with grade 2 or 3 penetration ($P = .0645$). Grade 2 or 3 penetration occurred in 18.2% of filters less than 30 days old but in 57.3% of filters 30 days old or older ($P < .0001$). Grade 2 or 3 penetration occurred in 45.0% of filters less than 180 days old but in 64.1% of filters 180 days old or older ($P < .0001$). Neither gender nor race