

Endovascular Removal of Inferior Vena Cava Filters with Arterial Penetration

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ABSTRACT

Purpose: To evaluate the safety and outcomes of endovascular percutaneous removal of inferior vena cava filters (IVCFs) with elements penetrating an artery.

Materials and Methods: From an IVCF retrieval database, computerized tomographic scans of patients who underwent IVCF retrieval from 2011 to 2017 were reviewed for IVCF elements penetrating through the caval wall and into an adjacent arterial wall (AW) or penetrating into an adjacent arterial lumen (AL). Forty-two patients were identified, including 20 with elements penetrating into an AW and 22 with elements penetrating into an AL; 30 of these IVCFs were tip embedded.

Results: All of the filters in both groups were removed. Of the arterial-interacting filters, 9 were removed with the use of standard techniques and 33 with the use of endobronchial forceps. Arterial access was obtained before removal in 3 patients (7%) with post-removal arteriography revealing no abnormalities, such as extravasation, pseudoaneurysm, or new fractured components. There was no significant difference between groups in tip embedding, retrieval technique, or fluoroscopy time.

Conclusions: Endovascular removal of IVCFs with elements that have penetrated into adjacent arterial walls or lumens can be performed safely in the majority of patients.

ABBREVIATIONS

AL = arterial lumen, AW = arterial wall, IVCF = inferior vena cava filter

The majority of inferior vena cava filters (IVCFs) are designed with expandable elements that use axial force and small hooks to prevent device migration. This design may promote penetration of elements through the walls of the inferior vena cava, a finding seen in up to 19% of IVCFs and

1 that increases with longer dwell times (1). Given the proximity of arterial vasculature, penetration into these structures occurs and the optimal method for managing arterial penetration is not well established.

A wide range of management techniques have been reported in the literature, ranging from expectant management to open aortic repair (2–9). We are aware of no case series describing this finding and no subgroup analysis in the literature. Sequelae of penetration into the aorta have been described from asymptomatic and detected incidentally on imaging to published individual cases associated with development of mycotic aneurysms and periaortic abscesses (2,10,11). Given the paucity of data, the optimal management of IVCFs with penetration into adjacent arteries is unknown. The purpose of the present study was to evaluate the safety and outcomes of percutaneous removal of IVCFs that have penetrated into adjacent arterial vasculature.

MATERIALS AND METHODS

Patient Selection and Data Collection

This study was carried out in compliance with the Health Information Portability and Accountability Act and was approved by the Institutional Review Board. A review of

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Figure. A 39-year-old woman with history of ulcerative colitis and large-volume deep-vein thrombosis with IVCF placed at an outside hospital 796 days before the removal procedure. (a) Preoperative CT angiography performed the day of removal demonstrates a Celect filter (Cook Medical, Bloomington, Indiana) with an element penetrating the aortic lumen with surrounding thrombus. The patient had been recommended to have an aortic endograft placed over the filter element and clot. She sought a second opinion. (b) Cavogram demonstrates a fractured tip-embedded filter. (c) Both common femoral arteries were accessed by means of surgical cut-down and temporarily occluded to prevent distal emboli. Aortography was performed, redemonstrating thrombus adherent to the penetrating IVCF leg. (d) Cavogram after endobronchial forceps removal of the IVCF and fractured elements via the right internal jugular vein demonstrates no arteriovenous fistula. (e) Balloon thrombectomy was attempted without success in removing the thrombus. Postoperative CT angiography demonstrates unchanged thrombus adherent in the aorta. (f) Patient was started on therapeutic anticoagulation with resolution of thrombus on follow-up CT angiography and no clinical sequelae during ongoing follow-up to 820 days.

patients who underwent percutaneous removal of an IVCF with elements penetrating into an arterial wall from August 1, 2011, to October 1, 2017, at a tertiary academic medical center was performed. Study subjects were identified from a dedicated prospectively acquired IVCF removal quality assurance (QA) database compiled daily from the interventional radiology division's master QA database (Hi-IQ; Conexsys, Lincoln, Rhode Island). Arterial interaction was determined by evaluating preoperative computerized tomographic (CT) imaging. Patients were classified into groups as non-arterial interacting and wall penetrating. Wall penetration was defined as the element abutting the wall without a definite intraluminal component. Lumen penetration was defined as a portion of the IVCF element visualized within the arterial lumen.

The electronic medical records and procedure notes of each patient were examined for details including technical success and complications, comorbidities, age at time of procedure, type of IVCF, placement and removal indications

according to Society of Interventional Radiology Quality Improvement Guidelines, previous removal attempts, element complications, tip embedded, removal technique, contrast volume, fluoroscopy time and dose, and availability and results of follow-up CT (12). Cross-sectional imaging of the IVCF and abdomen before and after the removal procedure was reviewed and recorded.

All procedures were performed by 1 of 7 interventional radiologists (all certificate of added qualifications certified or eligible) or by trainees under the direct supervision of an attending physician, board certified or board eligible, with an average experience of 16 years (range 6–24 y). All patients were seen by the performing interventional radiologist in the outpatient clinic before the scheduled removal procedure. Patients with indwelling IVCFs for >6 months underwent preoperative CT venography. Preoperative imaging was reviewed prospectively by the performing interventional radiologist, and relevant findings, including arterial penetration and risks, described and explained to the patient and documented.

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