

Percutaneous Extraction of Embolized Intracardiac Inferior Vena Cava Filter Struts Using Fused Intracardiac Ultrasound and Electroanatomic Mapping

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ABSTRACT

This report describes the percutaneous extraction of embolized intracardiac inferior vena cava (IVC) filter struts using fluoroscopy and fused intracardiac echocardiography and three-dimensional electroanatomic mapping. Six patients with indwelling IVC filters placed at outside institutions 5 months to 14 years previously presented with cross-sectional imaging of the chest demonstrating fractured IVC filter struts embolized to the myocardial free wall (four patients) or interventricular septum (two patients). All embolized filter struts were successfully retrieved, and open heart surgery was avoided.

ABBREVIATIONS

DVT = deep venous thrombosis, EA = electroanatomic, ICE = intracardiac echocardiography, IVC = inferior vena cava, 3-D = three-dimensional

Inferior vena cava (IVC) filters are generally safe to place with a mortality rate of 0.13% (1), but potential complications can occur, including bleeding, hematoma, IVC perforation, and IVC filter strut fracture and migration, which have been reported at a rate of 12%–25% (2–4). Numerous studies have documented the potential risks of filter strut fracture and migration. In particular, migration to the myocardium can result in cardiac tamponade and life-threatening arrhythmia (3,5–7). In these rare cases, the patients went on to either open heart surgery (3,5,6) or percutaneous retrieval with snare devices (7,8) to recover the filter struts. Overcoming potential complications and the technical challenges in percutaneously retrieving intracardiac filter

struts have not been previously addressed (7,8). This report describes the use of intracardiac echocardiography (ICE) and three-dimensional (3-D) electroanatomic (EA) mapping to safely retrieve intracardiac embolized filter struts using various percutaneous techniques.

CASE REPORTS

Institutional review board approval was obtained for this report. Six female patients with IVC filters placed at outside institutions presented between 2011 and 2014 with cross-sectional imaging of the chest demonstrating intracardiac embolized IVC filter struts. Patient age, chief complaint, filter dwell time, filter type, embolization site, retrieval device, complications, and incidental findings are summarized in the **Table**. All procedures were performed in a hybrid operating room/angiography suite with a Siemens Artis zee ceiling-mounted single-plane fluoroscopy unit (Siemens Healthcare GmbH, Erlangen, Germany). The previously placed indwelling filter was removed in all patients. All six patients underwent ICE with a 10-F SoundStar 3-D diagnostic ultrasound catheter (Biosense Webster, Inc, Diamond Bar, California) and 3-D EA mapping (Biosense Webster, Inc) with a Blazer II 7-F/4-mm standard curve/extended distal length ablation catheter (Boston Scientific, Marlborough,

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Table . Patient Demographics, Chief Complaint, Filter Type and Dwell Time, Filter Strut Location, Retrieval Device, Complications, and Incidental Findings

Case	Age (y)	Chief Complaint	Filter Type	Filter Dwell Time	Filter Strut Location	Retrieval Device	Complications	Incidental Findings
1	21	Chest pain, right upper quadrant pain	Bard G2	17 mo	Ventricular septum	4-mm-diameter × 0.018-in microsnare	None	Ventricular tachycardia requiring rescheduling of procedure
2	42	Vague abdominal pain	Bard G2	8 y	Right ventricular free wall	15-mm EN Snare device	None	Short RP tachycardia suspicious for AV nodal reentrant tachycardia during catheter manipulation; treated with ablation 7 mo later
3	67	Back pain	Bard Recovery	8 y	Ventricular septum	10-mm loop snare	None	Medically treated for long RP; narrow-complex supraventricular tachycardia noted during procedure
4	39	Cough, shortness of breath, chest and abdominal pain	Simon Nitinol	14 y	Right ventricular free wall	Cook Vascular Retrieval Forceps, laser assistance with parent filter extraction	Right neck cellulitis treated with antibiotics	None
5	51	Chest pain	Bard Eclipse	5 mo	Right ventricular free wall	10-mm loop snare	None	None
6	47	Chest pain	Bard G2	10 y	Right ventricular free wall	Cook Vascular Retrieval Forceps	Atrial fibrillation requiring cardioversion. No recurrence of arrhythmia and negative 21-d ambulatory electrocardiographic monitoring	None

AV = atrioventricular, RP = R and P wave interval on electrocardiogram.

Massachusetts) and fluoroscopic guidance to aid in retrieval of the fracture fragments. ICE was performed for monitoring image registration into the CARTO 3 3-D EA mapping system (Biosense Webster, Inc). Radiolucent defibrillator patches were applied to all patients in case emergent cardioversion was needed. All filter struts were withdrawn into a vascular sheath before crossing a valve plane, and ICE confirmed no pericardial effusion at the end of all procedures. Cardiothoracic surgery was

available for all cases but was not needed. Case 1, being the first case performed, is described in detail, and salient points from the remaining cases are described.

Case 1

A 21-year-old woman with multiple injuries following a motor vehicle accident presented 17 months after placement of a Bard G2 filter (Bard Peripheral Vascular, Inc, Tempe, Arizona) with a cardiac computed tomography

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