Fractured Inferior Vena Cava Filter Strut

Presenting with ST-Segment Elevation and Cardiac Tamponade

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The fracture of an inferior vena cava filter strut and its migration to the heart is a rare sequela of implanted inferior vena cava filters. Perforation through the right ventricle into the pericardium with resultant cardiopulmonary compromise is even less frequent. We report the case of a 53-year-old man who presented with chest pain and hypotension consequent to cardiac tamponade. A fractured inferior vena cava filter strut had migrated and perforated his right ventricle. The fractured strut was successfully removed by means of cardiac surgery. Inferior vena cava filters should be placed when necessary to minimize the risk of pulmonary embolism, and regular radiologic monitoring should be performed; however, the eventual extraction of retrievable filters should be considered. In addition to discussing the patient's case, we briefly review the relevant medical literature. ***(Tex Heart Inst J 2015;42(2):181-3)***

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Inferior vena cava (IVC) filters were first introduced in 1967, to prevent pulmonary embolism (PE) when anticoagulation is contraindicated or has failed in patients who have venous thromboembolic disease. In addition, IVC filters are used prophylactically in patients who have a high risk of PE. Implanted IVC filters are associated with such long-term sequelae as thrombotic occlusion of the IVC, vena cava perforation, and filter dislocation and migration.[1]

Inferior vena cava filter fracture has been reported in less than 1% of cases,[2] and the fracture of an IVC filter strut with its subsequent migration to the heart is apparently even less frequent.[3] We report the case of a man who presented with ST-segment elevation and cardiac tamponade after an IVC filter strut fractured, migrated, and perforated his right ventricle (RV). We also briefly review the relevant medical literature.

Case Report

In November 2010, a 53-year-old man presented at the emergency department 5 hours after the sudden onset of left-sided chest pain. His medical history included intracranial hemorrhage after head trauma 5 years earlier; afterwards, he had experienced seizures that were treated with antiepileptic medications. He had also had a Bard G2® retrievable IVC filter placed during his hospitalization for the intracranial hemorrhage; however, he did not report this to the physicians at the current admission. His vital signs on admission included a blood pressure of 90/56 mmHg, a heart rate of 101 beats/min, a respiration rate of 19 breaths/min, and an oxygen saturation of 98% on room air. An electrocardiogram showed sinus tachycardia at the rate of 117 beats/min and ST-segment elevation in the inferior leads.

The patient was started on intravenous fluids and a dopamine infusion and was urgently taken to the cardiac catheterization laboratory. During angiography, the patient became hemodynamically unstable; his systolic blood pressure fell to 60 mmHg. Left-sided heart catheterization was performed through femoral access. The left main coronary artery was normal. There was an eccentric 70% stenosis in the proximal left anterior descending coronary artery (LAD) and a 60% stenosis in the mid-LAD. The first obtuse marginal branch was large and had an 80% stenosis. The ostial right coronary artery (RCA) had a 75% stenosis, and the mid RCA had a 70% stenosis. The patient's left ventricular ejection fraction (calculated by means of contrast ventriculography) was 0.70. During fluoroscopy, a small metal object was visible in the

RV territory, but it was not clear if this was inside or outside of the heart. Of note, right-sided heart catheterization showed an equalization of diastolic pressures in all chambers of the heart, suggesting cardiac tamponade. An urgent bedside echocardiogram revealed a small pericardial effusion and evidence of cardiac tamponade.

The patient was taken to the operating room and underwent pericardial fenestration, with drainage of 450 mL of blood. His blood pressure improved after the procedure. A computed tomogram (CT) of the chest and abdomen revealed a slightly curved foreign body. It was partially in the RV and had traversed the anterior RV wall into the pericardium (Figs. 1 and 2). An abdominal CT showed an IVC filter with a missing anterior strut (Fig. 3). The patient underwent surgical extraction of the IVC filter strut, which had perforated the diaphragmatic surface of the RV. He had an uneventful recovery and was discharged from the hospital after 5 days.

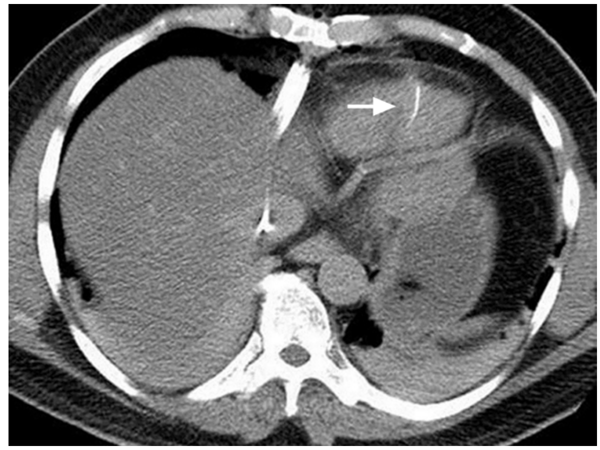

Fig. 1 *Computed tomogram of the chest and abdomen shows a fractured inferior vena cava filter strut (arrow) in the right ventricle.*

Fig. 2 *Longitudinal section of a computed tomogram of the chest and abdomen shows a fractured inferior vena cava filter strut (arrow) at the inferior border of the heart.*

Discussion

This was a rare case of IVC filter fracture that led to cardiac tamponade. Inferior vena cava filters are used to prevent PE in patients in whom anticoagulation therapy is ineffective or contraindicated. The caliber of the IVC varies with respirations, cardiac function, and intravascular volume; these factors can contribute to metal fatigue and strut fracture, although IVC strut fracture is apparently very infrequent.

When implanted for long periods (1,946 d in our patient), IVC filters theoretically sustain more metal stress. Lynch and colleagues[4] retrospectively reviewed the removal of Bard G2 IVC filters in 174 patients whose implantation periods were longer or shorter than 180 days. Of 174 G2 filters, 170 were removed (success rate, 97.7%). Of the 6 filters that had fractured (3.4%), all had been in place longer than 180 days.[4]

Inferior vena cava filter migration to the right atrium and the RV has been described. In 1996, James and associates[5] reviewed 22 cases of Greenfield IVC filter migration to the heart: 15 devices had embolized to the right atrium, one to the RV, 3 to the right pulmonary artery, one to the left pulmonary artery, and one to the "atrium."[5] In the 22nd patient, who died, the IVC filter was attached to the myocardial wall. Ten patients were asymptomatic, 4 presented with arrhythmias, and one had pericardial tamponade. In 2004, Izutani and co-authors[6] reported 12 cases of IVC filter migration to the heart (5 to the right atrium, 5 to the RV, and 2 to the pulmonary artery). Half of these patients were asymptomatic. No filter-related death was recorded, although 4 patients had arrhythmias.

Nicholson and colleagues[7] conducted a retrospective study of 80 patients to determine the prevalence of fracture and embolization of the Bard Recovery® and G2 vena cava filters. Thirteen of 80 patients had at least one strut fracture (16%). Of the 28 Recovery filters, 7 had at least one fractured and embolized strut (25%). Six of 52 G2 filters fractured (12%). The average time between Recovery filter implantation and evaluation of filter integrity was 1,498 days; for the G2 filter, it was 717 days. The average placement durations for patients in whom fracture was observed in the Recovery and G2 groups were nearly identical to those of all patients in those respective groups. The authors suggested that filter fractures might be a class effect and not limited to a specific design. Nevertheless, the effects of such fractures can vary. For example, Bard retrievable filters have radially distributed arms that are connected only at a single point. Therefore, a single fracture would result in a free fragment capable of embolization and potentially dangerous consequences, as in our patient.

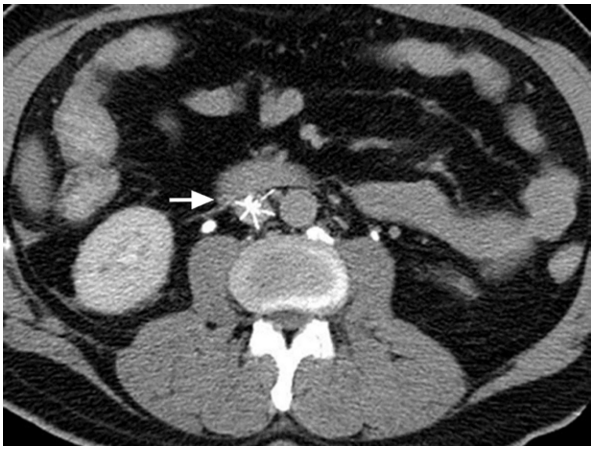

Fig. 3 *Computed tomogram of the abdomen shows the missing filter strut anteriorly (arrow).*

Because filter fragmentation and embolization might occur secondary to metal fatigue and be related to the duration of implantation, it is prudent that patients be evaluated regularly for evidence of filter fracture. In addition, each patient who has a retrievable filter should be considered for filter retrieval. Vijay and associates[8] retrospectively reviewed a database of fractured IVC filters, to understand the risks of IVC filter fracture and embolization and the safety of removing fractured filters. In 63 fractured Recovery, G2, and G2 Express® IVC filters identified in 548 patients, the overall fracture rate was nearly 12%. The occurrence of fracture increased with longer filter implantation durations. The success rate for removal of the nonfractured main body was 98.4%, and it was 53.4% for fractured arms or legs. The authors concluded that such removals can be safely and effectively achieved.[8] The U.S. Food and Drug Administration has recommended that physicians who perform implantations and clinicians who monitor patients with retrievable IVC filters consider filter removal as soon as the risk of PE has diminished. Consideration of the risks and benefits of filter placement in each patient is encouraged.[9]

The presentation of IVC filter-strut fracture can be varied and misleading. Our patient's chest pain and ST-segment elevation raised suspicion of myocardial infarction and prompted a diagnostic angiogram. Echocardiography followed by CT is ideal for the diagnosis of possible filter fracture and migration, and cardiac surgery with or without cardiopulmonary bypass is the treatment of choice for extracting fractured filter struts.

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