Brief Reports

Fragmentation, Embolization, and Left Ventricular Perforation of a Recovery Filter

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The Recovery retrievable inferior vena cava filter (C. R. Bard, Tempe, Arizona) was approved in the United States for temporary and permanent prophylaxis against pulmonary embolism. A few reports in the literature document fracture and migration of the Recovery filter or filter fragments into the heart. The authors report a case of delayed intracardiac migration of a fractured wire from this filter and describe the clinical course of a patient in whom this complication was managed.

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Abbreviations: IVC = inferior vena cava, MAUDE = Manufacturer and User Device Experience

THE Recovery nitinol filter (model G1; C. R. Bard, Tempe, Arizona) is an inferior vena cava (IVC) filter that was introduced in 2002 as a permanent filter and in 2003 as a retrievable filter. It is built with two "layers" of six radially symmetrically arranged metallic struts. The upper, shorter set serves as alignment struts to reduce angulation of the device with respect to the axis of the IVC. The lower, longer set contains hooks that anchor the filter to the IVC wall. Although this filter is safe and effective in most patients, reports of its migration and fragmentation led to its removal from the medical device market and reengineering of the filter to improve its stability and integrity. The reengineered filter, the Recovery G2 filter, was introduced in 2005 as a permanent filter and in 2008 as a retrievable filter. There have been several hundred reported complications of both the G1 and G2 filter, including a few deaths (Manufacturer and User Device Experience [MAUDE] database).

In this article, we report a case of fracture and migration of a G1 filter 3 years after initial implantation, resulting in left ventricular perforation and requiring surgical retrieval of the filter.

CASE REPORT

Institutional Review Board approval is not required by our institution for case studies. A 47-year-old man with a medical history significant for lower extremity deep vein thrombosis, presented at an outside hospital with a 2-week history of worsening chest pain. Initial testing included a treadmill test, stopped in the first minute of stage three for shortness of breath and slight chest discomfort relieved with nitroglycerin tablets, but without ischemic changes on the electrocardiogram, and cardiac catheterization, which showed normal coronary arteries. The patient noted a new left shoulder pain, which progressed over the next week to an excruciating 10 of 10 sharp shooting pain in his shoulder. Medical treatment consisted of nitroglycerin and nonspecific pain medications. His physical examination was unremarkable, and vital signs were within normal range. A Recovery filter had been placed while at a regional hospital 3 years earlier for lower extremity deep vein thrombosis provoked by knee surgery, initially treated by Lovenox and Coumadin, which were discontinued and replaced by an IVC filter after hematuria developed. The patient had then been lost to follow-up. In general, it is recommended for the implanting physician to follow up on these patients.

The patient was then transferred at his request to our institution. A bedside echocardiogram including color Doppler and intravenous contrast agent found a linear echodensity beneath the posterior leaflet of the mitral valve, anatomically normal valves without insufficiency, no evidence of patent foramen ovale, and no wall motion abnormality. A chest computed tomography (CT) was obtained, which showed the presence of two metallic foreign bodies, a longer one and a shorter one. The longest foreign body had perforated the inferior wall of the left ventricle, with the tip resting against the pericardium near the diaphragm. This was accompanied by a moderate pericardial effusion, evidence of local inflammation of the diaphragm near the tip of the foreign body, and small lower lobes subsegmental chronic pulmonary emboli.

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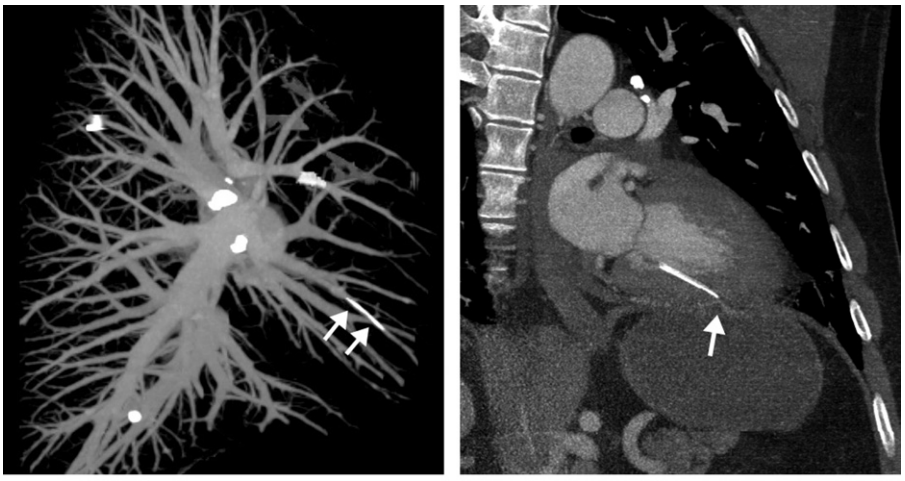
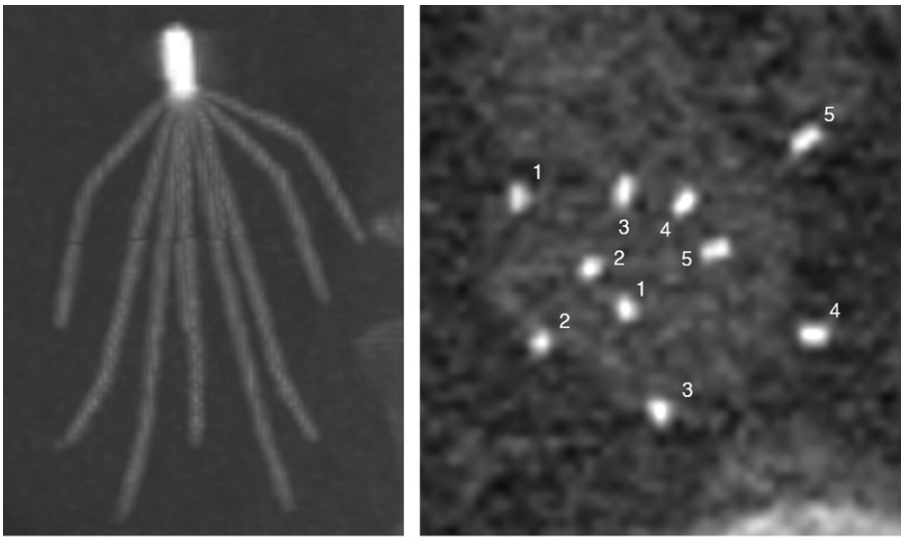


a. b.

Figure 1. CT scan shows metallic foreign body (arrows) in the right middle pulmonary artery (**a**) and inferior wall of the left ventricle (**b**). There is complete perforation of the left ventricular wall by the foreign body, with the tip resting against the pericardium near the diaphragm. A prominent branch of the phrenic artery (arrow) is noted near the tip of the foreign body because of local inflammation of the diaphragm.



a. b.

Figure 2. CT scan shows missing alignment strut and anchor strut in Recovery filter. The maximum intensity projection image of the filter (**a**) shows only five long anchor struts. Cross-sectional imaging through the struts (**b**) shows only five peripheral anchor struts and five central alignment struts. Two of the peripheral anchor struts (#4 and #5) are shown penetrating the IVC wall. Closer to the filter base, anchor strut #1 also penetrated the IVC wall.

The shortest foreign body was located in a peripheral branch of the right middle pulmonary artery (Fig 1). An abdominal CT study showed the absence of one of the short "alignment" limbs and of one of the long "anchor" limbs of the Recovery filter (Fig 2).

The patient was taken to the operating room and, after thoracotomy, underwent cardiopulmonary bypass and cardioplegic arrest. A large amount of bloody pericardial fluid was encountered. The embedded migrated filter leg protruded from the trabeculae beneath the posterior leaflet of the mitral valve, and was extracted easily. Intracardiac structures, including the right and left ventricles and all four valves, were normal. An abraded area on the left dome of the diaphragm was observed where the filter strut had perforated the left ventricular wall. The fragment of the filter, which had migrated into the branch of right middle pulmonary artery, was not removed. The patient recovered well after the surgery. Because of the limb migration, we anticipated that the device would be somewhat precariously attached to the IVC wall and was a risk for further fragmentation and embolization. Consequently, we recommended removal. Three days later, the remaining portion of the Recovery filter was retrieved successfully at the interventional radiology suite via the jugular approach using the Recovery cone retrieval system (C. R. Bard). Injection of the IVC before removal showed mural filling defects at the level of the filter consistent with intimal hyperplasia. There was a 25% diameter stenosis immediately below the apex of the filter (Fig 3). The angiographic minimal severity of stenosis as well as absence of collaterals in the ascending lumbar system suggested a hemodynamically nonsignificant stenosis. Despite absence of one alignment strut and one anchor strut, the device was firmly embedded, and removal required firm and sustained retraction, easily tolerated by the patient. The Instructions for Use recommend engaging the filter apex and retracting the filter into the sheath while keeping the sheath stationary. Because of the resistance encountered in retracting the filter, we deviated from the Instruction for Use and advanced the sheath while fixing the filter apex to reduce the risk of caval laceration. Retrieval was performed under conscious sedation and took approximately 10 minutes, from engaging the filter apex to removal through the neck. Repeat injection of the IVC after removal showed no contrast extravasation, but a vena cava stenosis remained after filter removal. Of note, the hooks of the embolized strut as well as one of the five remaining anchor struts were missing (Fig 4). There was no indication to implant a new IVC filter at that time, as the patient was not thought to have a hypercoagulable state. All subsequent chest CTs showed no additional pulmonary emboli, and none of