# Inferior Vena Cava Filter Embolus to the Right Ventricle: Anesthesia and High-Risk Percutaneous Procedures

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INFERIOR VENA CAVA (IVC) filters are used to prevent pulmonary thromboembolism. They are used in patients who have a contraindication to anticoagulation, failure of anticoagulation, and as prophylaxis in patients with a high risk of developing venous thrombosis.[1,2] In 2010, the United States Food and Drug Administration recommended that "implanting physicians and clinicians responsible for the ongoing care of patients with retrievable IVC filters consider removing the filter as soon as protection is no longer needed," as the organization recognized the increasing reports of complications associated with filters.[3] Filter retrieval is achieved in greater than 90% of attempts, but certain factors can make retrieval more difficult: Duration of filter in the body, tissue in-growth, thrombus within the filter, and filter tilt.[4,5] Complications of IVC filter placement include hematoma, thrombosis, migration, fracture, embolization, caval erosion, obstruction, and death.[1,6–10] IVC filter fracture and subsequent embolization have been reported, with a prevalence of up to 25% with certain types of filters, at times resulting in cardiac tamponade and ventricular arrhythmia.[11] The present case report describes an incident of complete IVC filter embolization to the heart, the subsequent presentation, and anesthetic technique for retrieval.

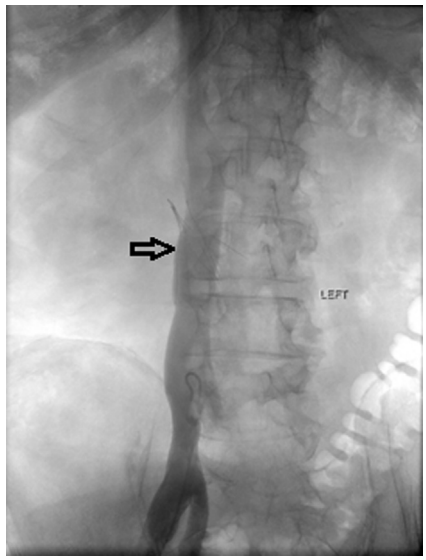


**Fig 1. Initial inferior vena cavogram showing the filter (black arrow) tilted in the infrarenal lumen with no intraluminal thrombus.**

## CASE REPORT

A 55-year-old morbidly obese man with chronic pain on methadone therapy but with no previous cardiac history presented with a deep venous thrombosis after gastric bypass surgery. An IVC filter was placed shortly thereafter because the patient could not be anticoagulated immediately postoperatively. A year after placement, the patient returned for filter removal while on warfarin with an international normalized ratio of 2.0. Initial inferior vena cavogram showed the filter tilted in the infrarenal IVC lumen with no intraluminal thrombus (Fig 1).

Under conscious sedation, the right internal jugular vein was accessed with a percutaneous snare device but the filter could not be captured. An endobronchial forceps was used as well, via the right femoral vein, but also could not capture the filter (Fig 2). Despite multiple interventional radiology (IR) operators and roughly 1.5 hours after initial retrieval attempt, the decision was made to abort the case due to significant retrieval challenge with nearly 5 Gray of radiation exposure and patient discomfort. The patient was to be discharged home and return within a month to have the filter removed under general anesthesia.

In the recovery room a few hours after the procedure, the patient began having nonsustained episodes of stable ventricular tachycardia. An electrocardiogram was obtained (Fig 3), which showed new, frequent premature ventricular complexes and an unchanged long QT interval and first-degree atrioventricular block. A transthoracic echocardiogram was obtained, which showed a left ventricle that was diffusely hypokinetic with an ejection fraction of 45%, no significant valve disorders, and a tubular echogenic object adjacent to the septal tricuspid leaflet and the basal septum of the ventricular side. The patient returned to the fluoroscopy suite, and imaging found filter embolization to the right ventricle. The tip of the filter lay below the tricuspid valve, without significant impact on the valve apparatus.

After a multidisciplinary team discussion, the decision to attempt percutaneous retrieval in a hybrid operating room was made. Cardioversion pads were placed, and a general anesthetic was administered with an arterial catheter and large-bore venous access before induction. Immediately afterward, a left internal jugular central venous introducer was placed followed by a transesophageal echocardiography probe. Cardiac surgeons were nearby and prepared for emergency cardiopulmonary bypass.

Interventional radiology attempts to capture the filter were unsuccessful and provoked unstable ventricular tachycardia, necessitating multiple cardioversions. Lidocaine and esmolol infusions were initiated, as well as an intravenous magnesium bolus, to provide stability and slowing to the myocardium

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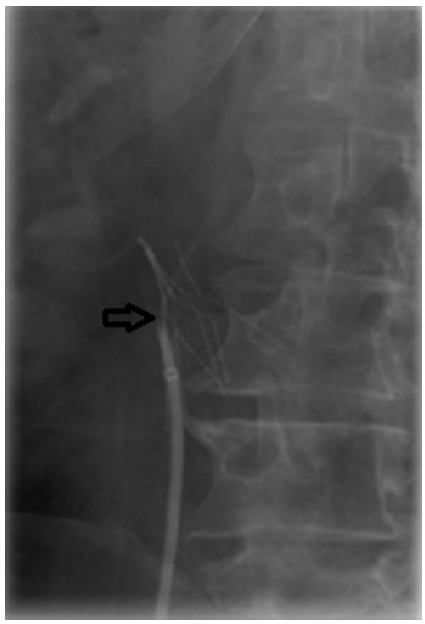

**Fig 2. Attempted capture of filter (black arrow) via the right femoral vein.**

for retrieval optimization.[12] Close communication among cardiologists for real-time echocardiography visualization, the anesthesia team for hemodynamics, and interventionalists for procedure mechanics was needed (Fig 4). A percutaneous snare device (Fig 5) via the right internal jugular vein lassoed the filter via a leg and pulled it to the right atrium, while a second snare via the right femoral vein approach (Figs 6 and 7) eventually then captured and retrieved the device from there (Fig 8, Video clip 1). Echocardiography confirmed no tricuspid insufficiency or pericardial effusion after the procedure. The patient was discharged home the next day with no significant postoperative complications or documented arrhythmia.

## DISCUSSION

There is currently no description of anesthetic techniques for retrieval of IVC filters that have embolized to the heart causing malignant arrhythmias. There are a few elements for the anesthesia provider to consider when perioperatively caring for such patients.

Patients with mechanical irritation of the myocardium will display varying degrees of electrical and mechanical disturbance. Placement of an arterial catheter preoperatively would be critical, and a central venous catheter for administering inotropes and anti-arrhythmics quickly for hemodynamic support would be necessary. The location of the central catheter should allow for the interventionalist also to obtain large central vascular access to retrieve the foreign body. Cardioversion pads should be placed, as electrical instability may occur. Live transesophageal echocardiography can be used to assist in filter localization, guide percutaneous retrieval, and monitor valve integrity.

Of note, transesophageal echocardiography was not placed initially because of concern that it may complicate placement of the left internal jugular introducer. It was discussed that the IR team would have its optimal retrieval conditions with right-sided internal jugular and right common femoral vein instrumentation, while cardiac surgery would pursue right-sided common femoral artery and vein access for emergency cardiopulmonary bypass if needed. Because the anesthesia team was equipped with real-time fluoroscopy in the operating room, it was believed that an introducer could be placed safely in the left internal jugular vein with fluoroscopic aid after large-bore peripheral venous access was obtained. The central catheter's J-tip wire was advanced just past the innominate vein, and the introducer was placed delicately and secured uneventfully. The transesophageal echocardiography probe then was inserted by cardiac anesthesia.

Large-bore intravenous access, type and crossmatch of blood type, and having blood products in the operating room in case of

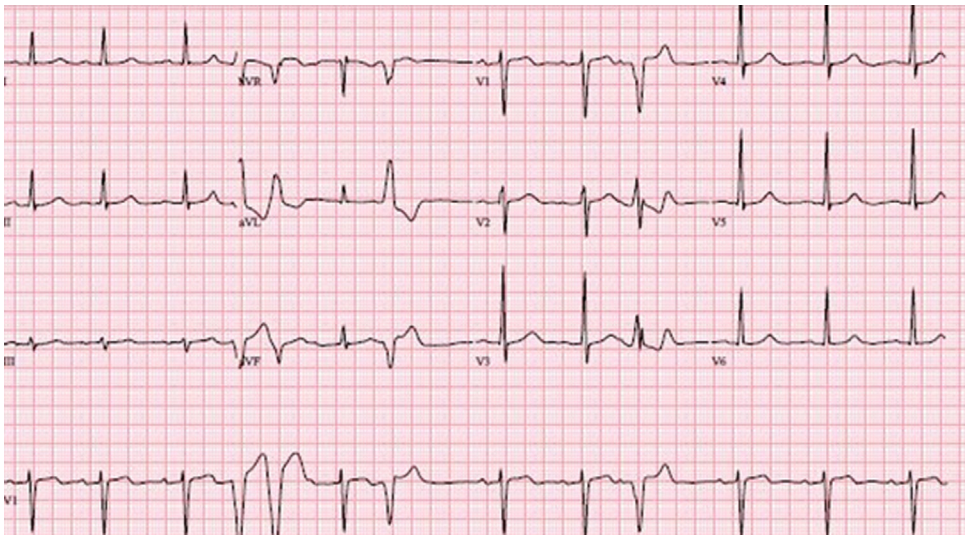


**Fig 3. The patient's electrocardiogram in the recovery room, showing frequent premature ventricular complexes, a long QT interval, and first-degree atrioventricular block.**