Surgical removal of a 'nonretrievable' inferior vena cava filter: A unique case requiring a median sternotomy and cardiopulmonary bypass

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An unsuccessful percutaneous removal of a caval filter that required retrieval through a median sternotomy and cardiopulmonary bypass is reported. Surgical options and techniques are discussed.

Key Words: AVC filter; Cardiopulmonary bypass; Surgery

Permanent caval filters were developed during the end of the 1960s. Unfortunately, such nonretrieval filters were plagued by long-term complications such as caval wall perforation and inferior vena cava (IVC) thrombosis. Retrievable IVC filters, on the other hand, were designed for patients with short-lived risk of thromboembolic complications. The objective of using these filters is to protect the patient during a high-risk thromboembolic period and subsequently remove the device to avoid the long-term complications of permanent filters. We describe a case of a 'retrievable IVC filter' that required removal through a sternotomy approach under cardiopulmonary bypass. Surgical options and techniques are discussed.

CASE PRESENTATION

A 24-year-old man was admitted with a fever, asthenia and a clinical examination compatible with septic shock. A right buttock abscess was diagnosed and drainage was performed immediately. The clinical picture was complicated by an intravascular disseminated coagulopathy, renal failure, a septic thrombosis of the IVC and a pulmonary emboli. Secondary to the septic pulmonary emboli, a necrotizing pneumonia with massive hemoptysis supervened. Considering the contraindications to pursuing a heparin perfusion, a retrievable IVC filter (OptEase; Cordis Corporation, Johnson & Johnson Inc, USA) was indicated and positioned in the infrarenal IVC. The patient gradually recovered and was referred for filter removal, considering the possibility to resume anticoagulation.

A first percutaneous attempt was performed through a femoral approach. The filter could not be mobilized and the attempt was abandoned. At that time, it was recognized that the filter was positioned upside down, with the filter barbs facing caudally. Thus, a second percutaneous attempt was planned to retrieve the device through a right jugular vein approach. The filter was displaced from its infrarenal position but blocked 2 cm beneath the sus-hepatic veins. At this level, the tip of the device tilted and perforated the posterior wall of the IVC, and was embedded within the liver parenchyma (Figure 1). An additional attempt to dislodge the device through the jugular vein using an angiographic balloon catheter to stir the device was unsuccessful. The situation was thoroughly discussed with the patient. Considering the localization in the vicinity of the sus-hepatic

L'ablation chirurgicale d'un filtre de la veine cave inférieure « inaccessible » : Un cas unique faisant appel à une sternotomie médiane et à un pontage cardiopulmonaire

On présente l'échec de l'ablation percutanée d'un filtre de la veine cave qui a dû être extraite par sternotomie médiane et pontage cardiopulmonaire. On expose les possibilités et techniques chirurgicales.

Figure 1 A thoracoabdominal computed tomography scan after percutaneous attempts to remove the inferior vena cava filter. **A** Sagittal view showing the position of the device approximately 2 cm beneath the level of the sus-hepatic veins. **B** Coronal view showing inferior vena cava wall penetration with the tip of the device embedded in the liver parenchyma

veins, long-term anticoagulation was advocated if the device was left in place. Furthermore, considering the initial septic IVC thrombus, infection of the device could not be ruled out. In light of this information, the patient elected to have the device removed surgically.

Two options were considered to approach the IVC and remove the device: either through an abdominal approach with hepatic exclusion or through a sternotomy with the use of cardiopulmonary bypass.

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Because of the proximity of the device to the sus-hepatic veins, a cavotomy to remove the device was deemed dangerous. Thus, the sternal approach was privileged. The cardiopulmonary bypass was instituted with a venous cannula in the right atrium and a femoral vein cannula positioned at the level of the renal veins. The patient's core temperature was reduced to 28°C. At this temperature, the inferior portion of the right atrium was snared and the IVC opened just above the sus-hepatic veins (Figure 2). Vision within the IVC was further enhanced by the use of an endoscope. The IVC filter was easily located. As suggested by the preoperative imaging, the tip of the device had perforated the posterior wall of the IVC and was embedded in the liver parenchyma. Using long-shafted instruments, the filter was removed without complication. Cultures of the filter showed growth of *Staphylococcus epidermidis*. The patient underwent an uneventful recovery following four weeks of antibiotic treatment.

DISCUSSION

Retrievable IVC filters were developed to protect patients from recurrent embolic phenomena and to allow for device removal once anticoagulation therapy is resumed. Interestingly, in series evaluating the use of retrievable IVC filters, attempts at device retrieval is performed in less than 50% of cases, while the removal success rate is higher than 80% (1-3). On the other hand, complications of IVC filters are highly variable and reported in 0% to 69% of cases (4). Complications seem to increase with time; IVC thrombosis and device fracture with IVC wall penetration are the most frequent complications encountered. Duodenal, aortic and retroperitoneal fistulas have also been reported (5).

The present case illustrates a complication of a retrievable IVC filter that required open surgery for removal. Retrieval of the device was complicated by inadvertent misloading of the device during implantation, which resulted in the device barbs facing caudally. Once the device was embedded in the retrohepatic IVC following the percutaneous removal attempts, there were two options: long-term anticoagulation with the device left in place or surgical removal. Considering the risk of long-term anticoagulation in the young patient and the suspicion of device infection, the patient elected for surgical removal.

The retrohepatic portion of the IVC is difficult to access surgically; thus, the surgical approach is of paramount importance. An abdominal approach with mobilization of the right liver lobe and cavotomy performed under hepatic exclusion usually allows for suitable access to the retro-hepatic IVC. Hepatic exclusion is performed by clamping the IVC above the sus-hepatic veins and above the renal veins, and by clamping the hepatoduodenal ligament (Pringle manoeuvre). However, we were concerned that the position of the device in the vicinity of the sus-hepatic veins could preclude safe device removal while clamping the sus-hepatic IVC within the abdomen. In addition, the sternotomy approach with the use of cardiopulmonary bypass was believed to be safer because the device barbs were oriented caudally, thus offering no obstruction to a removal through an intrapericardial cavotomy approach. The venous drainage for the cardiopulmonary bypass was performed with a cannula in the femoral vein that was positioned at the level of the renal veins and a second cannula inserted in the right atrium. The use of a femoral vein cannula and clamping of the right atrium above the intrapericardial IVC allowed for the operation to be conducted under low-flow cardiopulmonary bypass with moderate hypothermia and thus, avoid deep hypothermia and circulatory arrest. Once the IVC was opened above the sus-hepatic veins, the device could be visualized easily and safe device removal could be performed using long-shafted instruments guided by endoscopic imaging.

CONCLUSION

We have reported a unique complication of an infected retrievable IVC filter embedded within the retrohepatic IVC that was safely

Figure 2) Intraoperative photographs. **A** Venous cannula within the right atrium with a snare positioned at the junction of the right atrium and inferior vena cava (arrow). **B** Opening of the inferior vena cava above the sus-hepatic vein under low-flow cardiopulmonary bypass. The filter may be seen within the inferior vena cava

removed by an intrapericardial IVC cavotomy. Low-flow cardiopulmonary bypass with venous cannulation within the right atrium and the femoral vein, and the use of an endoscope further facilitated removal of the device.

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