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Transfemoral Approach Through Inferior Vena Cava Filters for Complex Cardiac Interventions: Expanding the Limits

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Abstract: Performing complex cardiac interventions that need atrial septal crossing in patients with a previously implanted inferior vena cava filter (ICVF) has proven difficult. Accordingly, some authors have chosen accesses different from the traditional femoral vein approach. Here, we report two cases of complex cardiac procedures performed via the femoral vein and through an IVCF. In the first case, a percutaneous mitral valvuloplasty was performed in an elderly woman after crossing the IVCF with a large sheath. In the second case, simultaneous left atrial appendage and patent foramen ovale closures were performed. In both experiences, the key step was to secure the access by positioning a long sheath with its tip above the IVCF and not removing it until the procedure had finished. These cases further support the use of traditional femoral vein access in patients with IVCF and confirm the possibility of performing complex cardiac interventions in these scenarios.

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Key words: femoral access, inferior vena cava filter

The femoral vein approach has been the mainstay for percutaneous cardiac procedures requiring atrial septum crossing, such as left atrial appendage closure and mitral balloon valvotomy. Traditionally, this route is not considered feasible in the presence of an inferior vena cava filter (IVCF). Hence, different access routes have been attempted in these situations.[1,2] We report two cases of complex structural cardiac interventions using femoral venous access in patients with previous IVCF implantation.

Case Descriptions

Case 1. *An 81-year-old female with a history of rheumatic mitral stenosis, previous surgical commisurotomy, atrial fibrillation, and pulmonary embolism for which she had received an IVCF (Optease, Cordis Corporation) three years prior was admitted to the coronary unit in acute pulmonary edema. After initial stabilization, transesophageal echocardiography showed severe mitral stenosis (estimated mitral valve area, 0.7 cm^2), a Wilkins score of 8, and preserved left ventricular systolic function. Because of her comorbidities, the patient was deemed a very high operative risk and surgical valve replacement was declined. Therefore, a percutaneous mitral valvuloplasty (PMV) was scheduled.*

Procedure 1. *After adequate skin preparation, access was gained from both femoral veins. Contrast media injection from the right femoral vein showed patency of the IVCF and no evidence of thrombus related to the device (Figure 1). After advancing a very soft 0.035˝ wire (Benson wire; Parkmore Business) through the IVCF, a 6 Fr balloon-tip catheter (Arrow International Inc) was placed across the filter and the wire was exchanged through this catheter for an extra-stiff wire. Over this wire, a 25 cm, 18 Fr sheath was introduced and positioned across the IVCF under strict fluoroscopic guidance, leaving the sheath tip above the IVCF. Then, the Benson wire was introduced from the left femoral vein and crossed the IVCF and the 6 Fr balloon-tip catheter was placed through the IVCF into the left pulmonary artery (Figure 2). All manipulations for the valvuloplasty were done through the 25 cm, 18 Fr sheath, obviating the need for further crossing the filter. Standard PMV was performed with a 26 mm Inoue balloon, achieving a satisfactory result. Radioscopy-guided retrieval of the pulmonary artery catheter and the PMV catheter through the IVCF was carefully performed, showing no*

evidence of IVCF dislodgment (Figure 3). Final contrast media injection confirmed the successful procedure, with no damage to the filter. Three days later, the patient was discharged uneventfully.

Case 2. *A 61-year-old male with a history of left ventricular systolic dysfunction, atrial fibrillation, and a spontaneous hemorrhagic cerebrovascular accident had an IVCF (Optease, Cordis Corporation) implanted 6 years ago after proximal deep vein thrombosis had developed. Due to formal contraindication to oral anticoagulation therapy and a CHADS2 score of 4, percutaneous left atrial appendage closure was planned. Transesophageal echocardiography showed suitable anatomy for a left atrial appendage closure device as well as a patent foramen ovale (PFO). Accordingly, simultaneous left atrial appendage and PFO closure were performed.*
Procedure 2. *Right femoral venous access was obtained and contrast media was injected to confirm the patency and absence of thrombus on the IFCV. A very-soft 0.035˝wire (Benson wire, Parkmore Business) crossed the IVCF, over which a 6 Fr catheter was advanced, allowing the exchange for a stiff wire. A large, 90 cm, 10 Fr sheath was inserted and positioned in the right atrium, crossing uneventfully through the IVCF (Figure 4). The Amplatzer releasing system was delivered to the right atrium via the large, 90 cm, 10 Fr sheath positioned through the IVCF, avoiding further manipulation at the level of the IVCF (Figure 5). Standard left atrial appendage closure was performed with an Amplatzer Cardiac Plug (ACP) #22 device (AGA Medical Corporation). Using the same releasing system, a #25 Amplatzer device for PFO closure was successfully implanted (AGA Medical Corporation). Continuous monitoring of the procedure with transesophageal echocardiography was performed and the correct deployment of both devices was secured (Figure 6). Careful x-ray guided retrieval of the trans-IVCF sheath was performed and final contrast media injection confirmed that no damage to the IVCF had occurred. After confirming the correct placement of both cardiac devices with echocardiography, the patient was discharged the following day.*

Discussion
IVCFs are commonly used after deep venous thrombosis and/or pulmonary embolism in patients who are not candidates for oral anticoagulation treatment or who have suffered a thromboembolism during appropriate antithrombotic therapy.[3] The presence of such a device has been considered a contraindication to catheter passage from the femoral vein to the right atrium because of fear of its dislodgment. Nevertheless, there are a limited number of reports showing the feasibility of the femoral vein approach for performance of complex structural heart interventions in patients with IVCFs, which have included PMV and atrial septal defect closure[4-6] as well as right heart catheterizations and electrophysiological studies.[7,8] Less commonly used alternative access routes (eg, transjugular or transhepatic) could be chosen, but are not without risk and are frequently more cumbersome, potentially causing a higher radiation exposure to the operator.[1,2]
As shown in the cases presented, there are a few considerations that must be taken into account before attempting to perform these procedures in patients with previously implanted IVCFs. The key step is initial contrast injection to confirm a patent, correctly positioned, and thrombus-free IVCF. Next, it is paramount to cross the filter using a soft wire and then a thin catheter, through which an extra-stiff wire is then exchanged. Later, the access should be secured by the careful positioning of a large sheath through the filter, leaving its tip above the filter and thereby minimizing any further filter manipulation and facilitating equipment and device delivery. Fluoroscopic imaging during any advancement and withdrawal of equipment (catheters, sheaths, wires) is important to avoid inadvertent filter dislodgment. Moreover, catheters and sheaths that cross the IVCF should be positioned and removed over an appropriate wire to avoid entrapment. Lastly, it is important to note that all manipulations should be done with extreme caution and gentleness to avoid untoward complications.

To our knowledge, this is the first report of left atrial appendage closure in patients with an IVCF and one of few reports of simultaneous left atrial appendage plus PFO closure.[9] In addition, large-bore sheath (18 Fr) placement through an Optease filter has never been reported. The cases presented show the feasibility of these procedures and further confirm that after securing the access with a large enough sheath with its tip above the filter, multiple interventions could be performed (PMV, PFO, and left atrial appendage closure in this series) without jeopardizing the correct positioning of the IVCF.

In conclusion, we believe that the presence of an IVCF should not be considered a formal contraindication for interventions requiring femoral vein access, although its performance would require a careful and skilled approach.

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Figure 1. *Contrast media injection demonstrating a patent and free-of-thrombus inferior vena cava filter.*

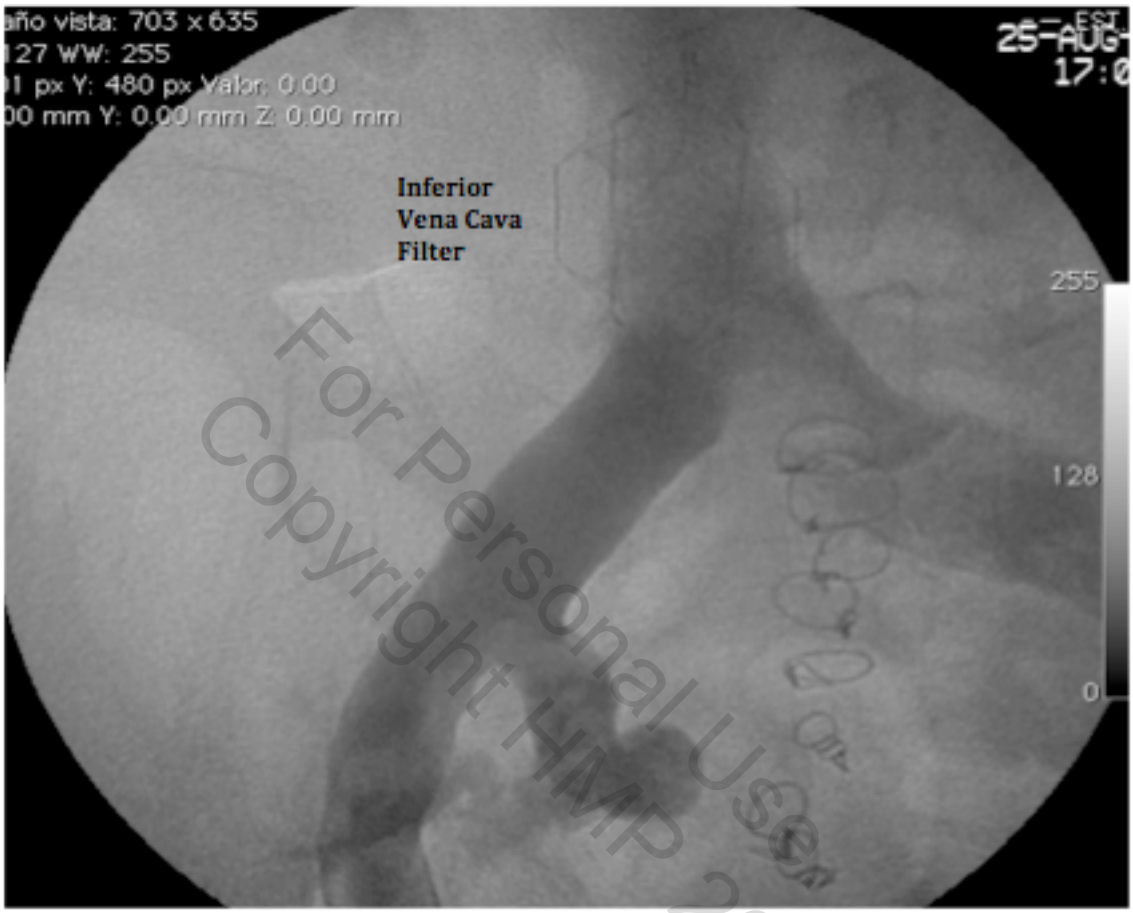

Figure 2. *An 18 Fr sheath and a balloon-tip catheter positioned across the inferior vena cava filter. Notice that the tip of the sheath is located above the filter, avoiding further manipulation of the device.*

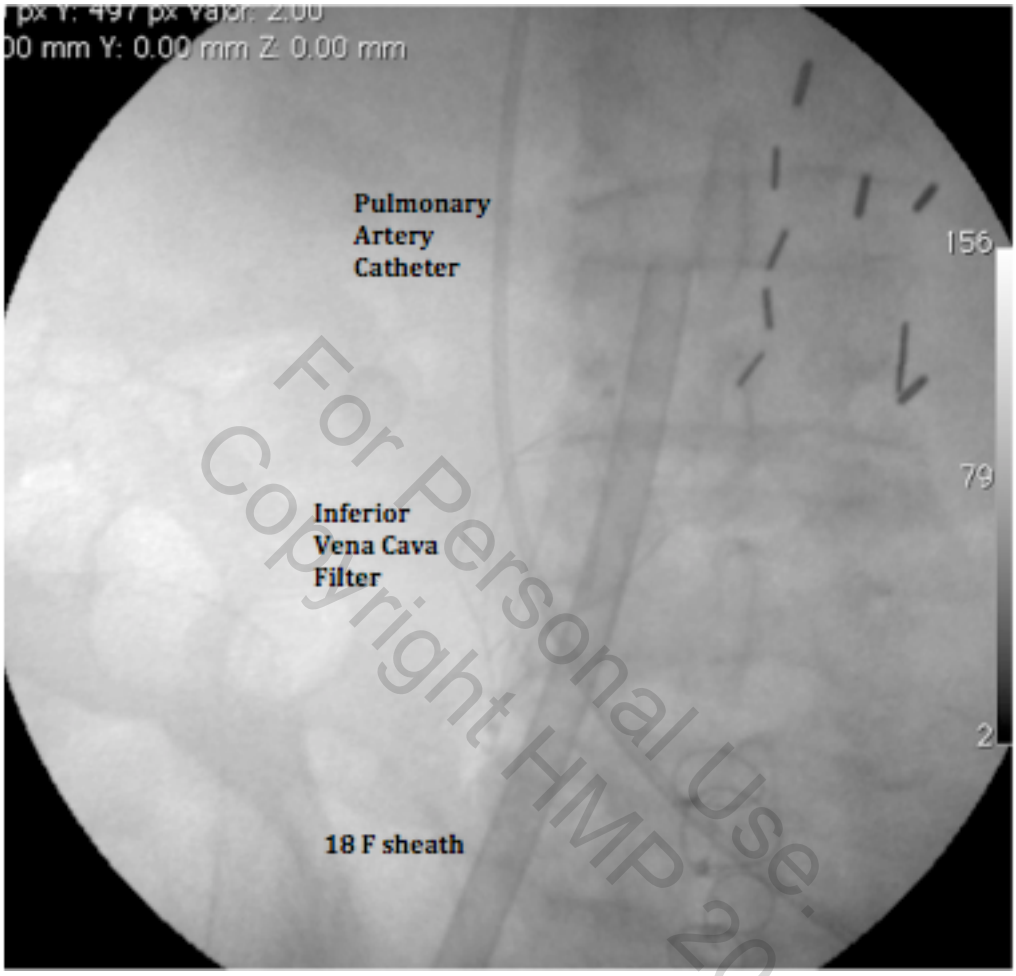

Figure 3. *Careful retrieval of the 18 Fr sheath and the pulmonary artery catheter. Notice that over-the-wire retrieval of the pulmonary artery catheter is being performed.*

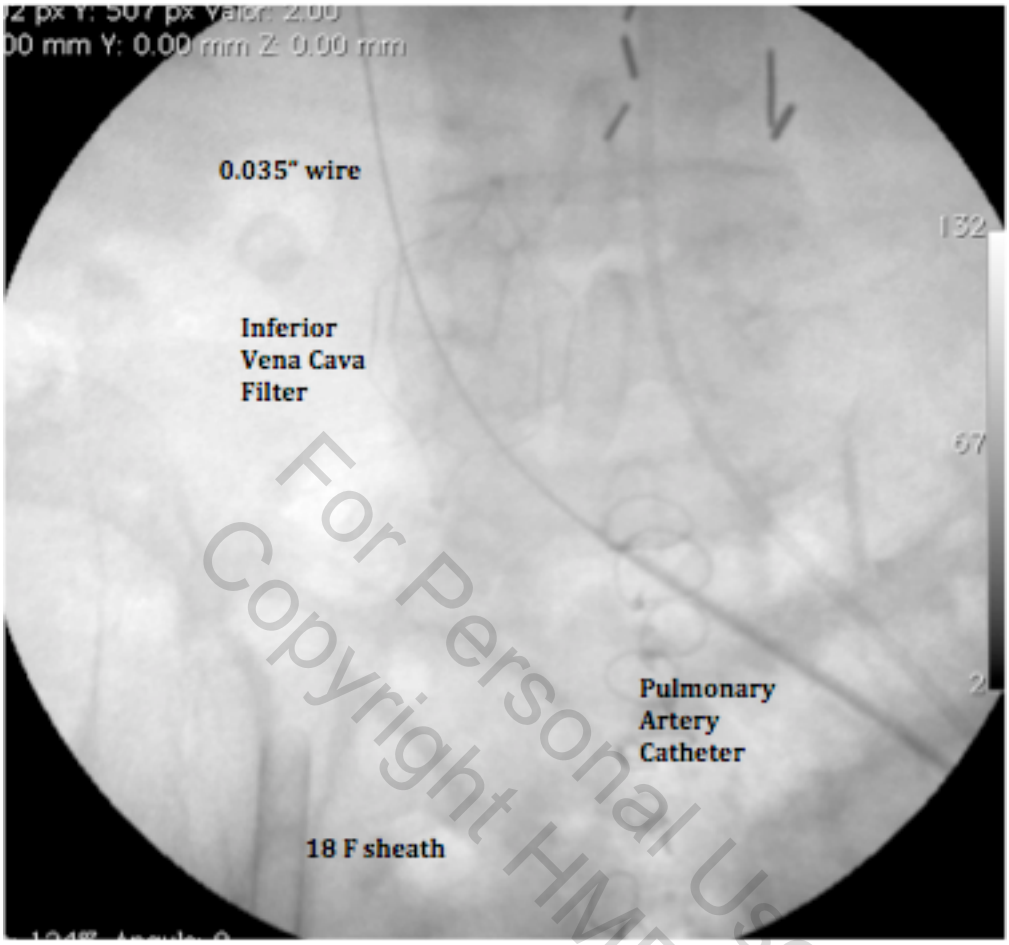

Figure 4. *Advancement of the 10 Fr sheath through the inferior vena cava filter, using a stiff wire.*

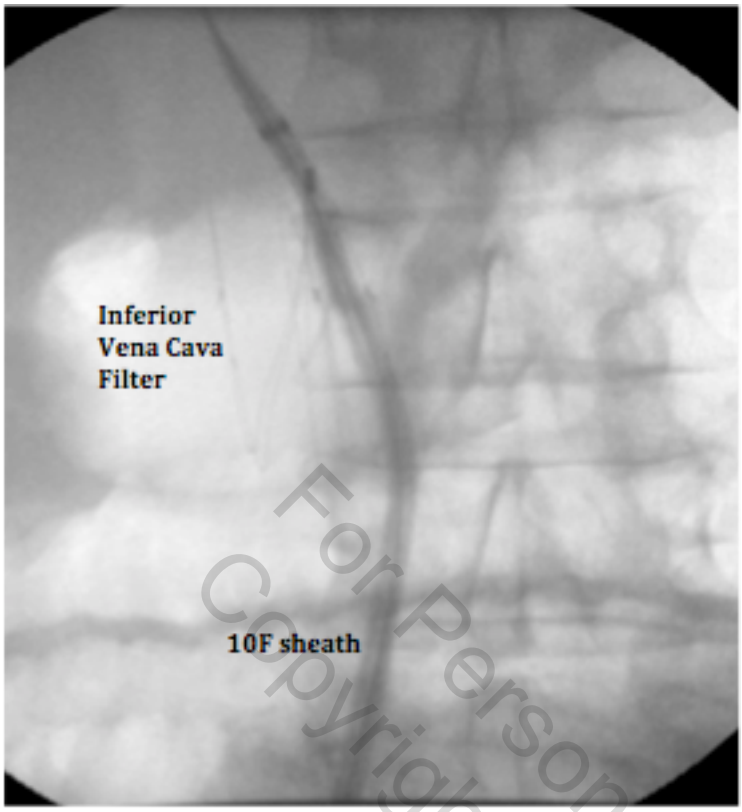

Figure 5. *Secure delivery of an Amplatzer Cardiac Plug #22 device inside the 10 Fr sheath, not jeopardizing the inferior vena cava filter.*

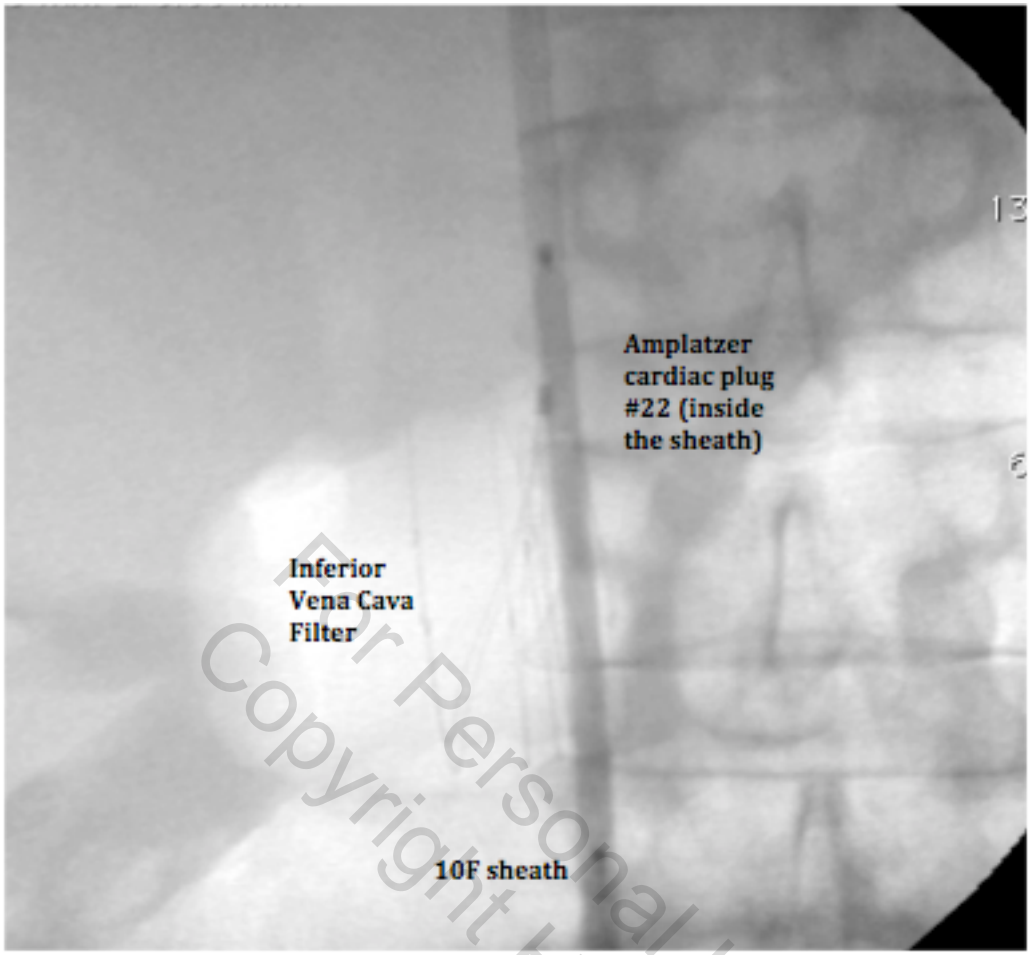

Figure 6. *Angiographic image of both Amplatzer cardiac plug #22 and patent foramen ovale #25 closure device correctly implanted in the same patient.*