PHYSICIAN
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ACCESS SITES

- The most common access site is the right common femoral vein (CFV) because this allows relatively straight entry into the vena cava. There tends to be less tilting of the filter during placement via the right CFV when compared with the left CFV.
- Other access sites, in declining frequency of use, include left common femoral vein, right then left internal jugular veins, right then left antecubital veins, and right and left subclavian veins, in rare instances. Some filters can be placed from multiple access sites, whereas others have limited usable access sites due to either the way the filter releases from the insertion mechanism or the size of delivery sheath. Check the instructions for use included in the manufacturer's insert for recommended access sites.

DIAGNOSTIC AND INTERVENTIONAL DEVICES USED

SHEATHS AND DIAGNOSTIC CATHETERS

The delivery sheath is supplied in the filter packet. However, I like to start with a 5-F sheath and a 5-F marker pigtail catheter for the initial diagnostic vena cavogram prior to opening the filter packet. One can substitute the above with a standard flush catheter and a radiopaque ruler. The vena cavogram allows adequate sizing of the vena cava, location of the renal veins, reveals the presence of venous anomalies, as well as the presence or absence of caval thrombus. Contrast opacification of the renal veins is not always necessary, as unopacified blood washing into the IVC will accurately locate the renal veins for filter positioning. However, occasionally both renal veins will not be satisfactorily localized with a flush venogram. In this case, use a 5-F Cobra catheter to engage and inject the renal veins to locate their origins. Reference their location to a bony landmark or mark their location on the fluoroscopy screen.

DIAGNOSTIC GUIDEWIRES

All filters are inserted over a .035-inch guidewire. Usually a 150-cm standard "work-horse" guidewire is all that is needed. When using an antecubital approach, use a 5-F multipurpose angiography catheter to navigate across the right atrium into the IVC and then use an exchange length (260-cm) guidewire to maintain IVC access while swapping out the multipurpose angiography catheter for the filter delivery sheath.

CONTRAST

I routinely use iodinated liquid contrast (eg, Isoview) for the vena cavogram. If the patient is allergic to iodine or has renal insufficiency, I use medical-grade CO_2 gas contrast. The CO_2 reservoir bag and delivery tubing are available from AngioDynamics, Inc. I do not use gadolinium for large-diameter vessels. After filter insertion, perform a hand-injection for documentation of filter alignment and position within the vena cava.

ADDITIONAL EQUIPMENT

Occasionally, a retrievable filter will tilt during placement, making future removal difficult or impossible. When this happens with the Günther-Tulip filter, use a snare catheter to engage the filter hook and capture the filter for redeployment. The same process can be used to reposition a Recovery filter using their retrieval cone. This process may require a different access site for cap-

ture and redeployment than was used for initial placement. Another way that I straighten a tilted Günther-Tulip filter is to use a Fogarty balloon catheter. Using the same access site as was used for the filter insertion, slide the catheter tip next to the tilted apex and inflate the balloon. This will push the apex of the filter into the center of the vena cava.

DIAGNOSTIC NOTES

The marker pigtail catheter should be placed into the lower vena cava with markers showing on the fluoroscopy screen. Injections of 20 mL of liquid contrast per second for 50 mL will usually opacify the cava, renal veins, and contralateral common iliac vein. It also helps restrict outflow and better opacify the cava, renal veins, and contralateral common iliac vein. A Valsalva maneuver helps restrict outflow and better opacify the renal and common iliac veins. This will also help identify a duplicated vena cava. If the patient is allergic to iodine and cannot be premedicated or has renal insufficiency, CO_2 gas contrast can be used instead of iodinated contrast. The filming rate for CO_2 gas contrast is increased to seven frames per second and around 40 mL of CO_2 should be hand-injected at a time. Clear the injection tubing of standing blood with 5 mL of CO_2 before injecting a larger volume of gas to prevent explosive delivery of the gas contrast. Understand that CO_2 displaces blood, in contradistinction to liquid contrast that mixes with blood, which will occasionally undersize the vena cava.

IMAGING NOTES

Digital subtraction angiography is preferred for liquid iodinated contrast, but not essential. However, for CO_2 gas contrast, Digital subtraction angiography is essential because of the lower visibility of gas in the vena cava. A power injector is used with standard contrast and hand injection with CO_2 gas contrast. Once the injection is completed, the table should not be moved nor should the magnification be changed. This will prevent parallax errors during filter insertion. The location of the lowest renal vein can be referenced to a bony landmark, such as a vertebral body endplate or pedicle.

FILTER INSERTION NOTES

- Place the filter as close to the lowest renal vein as possible. The apex of the filter will project at or above the renal vein, allowing for enhanced blood flow through the filter promoting autolysis of trapped emboli. Theoretically, this will optimize caval patency. Suprarenal placement should be reserved for specific indications, such as renal vein thrombus resulting in pulmonary embolism and caval thrombus preventing infrarenal placement.
- Attention to caval diameter is essential to prevent migration. Insert the filter below the hepatic veins. With vena cava diameters greater than 30 mm, consider using a Bird's Nest filter available from Cook, Inc. This filter is approved for use in vena cava diameters up to 40 mm and requires 5 cm of vena cava length for deployment. Another option is to place separate filters into both common iliac veins, especially when retrieval is anticipated.
- Use caution with borderline-sized vena cava diameters because this may pose a filter migration risk when the patient undergoes surgery within several weeks of filter placement. The IVC will distend with positive pressure ventilation and IV fluid administration during surgery.
- Filter placement considerations for the superior vena cava are similar to the IVC. You would want to place the filter between the right atrium and innominate veins. Remember to reverse the orientation of the filter to allow stabilization and clot trapping. ■