Transradial Access for Hepatic Oncologic Interventions

Considerations for choosing the right access equipment.

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Transradial access for image-guided interventions was first described in the early 1990s.[1] The significant benefit to high-risk patients has been well documented in the coronary space, with multiple randomized trials and meta-analyses demonstrating lower bleeding complications and mortality rates. For the interventional radiologist, the bleeding and mortality benefits are not directly translatable because the cardiology patients had more anticoagulation, larger sheaths were used for the procedures, there was a higher risk for major adverse cardiac events, and the use of ultrasound is not standard for access. The benefits of transradial access specific to interventional radiology include faster hemostasis, shorter time to postprocedural mobilization, and patient preference.[1-3]

The benefits of using a transradial access approach for hepatic oncologic procedures include ease of cannulation of the celiac artery and superior mesenteric artery due to anatomy, as well as rapid hemostasis and ambulation with subsequent accelerated discharge. These benefits apply to the majority of arterial oncologic interventions, with the most common being selective internal radiation therapy (SIRT) and transcatheter arterial chemoembolization (TACE).[2,3] With both procedures, knowledge of the equipment is essential, including awareness of the currently available inventory to allow therapeutic delivery, coil and liquid embolic delivery (if needed), and passage of antireflux devices or balloon occlusion catheters. This article focuses on the available equipment for radial oncologic procedures and how to use them in practice.

RADIAL SHEATHS

The radial artery is punctured with a 21-gauge needle, which is provided in all radial access sets, and the use of a radial hydrophilic sheath is highly recommended.[2] Various radial-specific hydrophilic sheaths are available, including PreludeEase (Merit Medical Systems, Inc.), Prelude Ideal (Merit Medical Systems, Inc.), and Glidesheath/Glidesheath Slender (Terumo Interventional Systems). The sheaths range in size from 4 to 7 F, and the choice of sheath size is determined by radial artery size and the equipment required for the procedure. The sheath size reflects the inner diameter (ID), and therefore, the outer diameter (OD) of the sheath is larger. The sheath size should generally only be as large as is required to complete a procedure, thereby minimizing trauma to the radial artery and reducing access complications. It is important to note that the Glidesheath Slender and Prelude Ideal sheaths are manufactured with thinner walls to allow for larger IDs. The 5-F Glidesheath Slender and Prelude Ideal sheaths have an OD similar to a 4-F standard vascular sheath but can accommodate a 5-F catheter and guiding catheter.

DIAGNOSTIC CATHETERS

Radial-specific catheters are available in lengths from 110 to 150 cm. In the majority of patients, a 125-cm catheter will allow for selection of the celiac axis or superior mesenteric artery and passage of a microcatheter. In our experience, a 5-F platform provides enough support for selection and stabilization within the vessels. A variety of shapes are available, but we have found the Ultimate 1 (Merit Medical Systems, Inc.) to be a robust catheter for all visceral selections.

The Sarah and Jacky Optitorque catheters (Terumo Interventional Systems) are similar to the Ultimate 1. However, the Ultimate 1 has slightly more vertical distal tips, which allow it to select similarly to a Cobra catheter when it is unfolded in the abdominal aorta, with support from its primary curve off the back wall.

The Ultimate 1 catheter is available in 4 F, but the support is limited in the 125-cm catheter, and therefore, selection can be challenging, particularly in elderly patients with

vascular disease. We limit our 4-F catheter use to younger patients and those undergoing pelvic interventions, where torque is not as important. Various catheter shapes and lengths are shown in Table 1, and the choice of catheter shape is operator dependent.

GUIDE CATHETERS

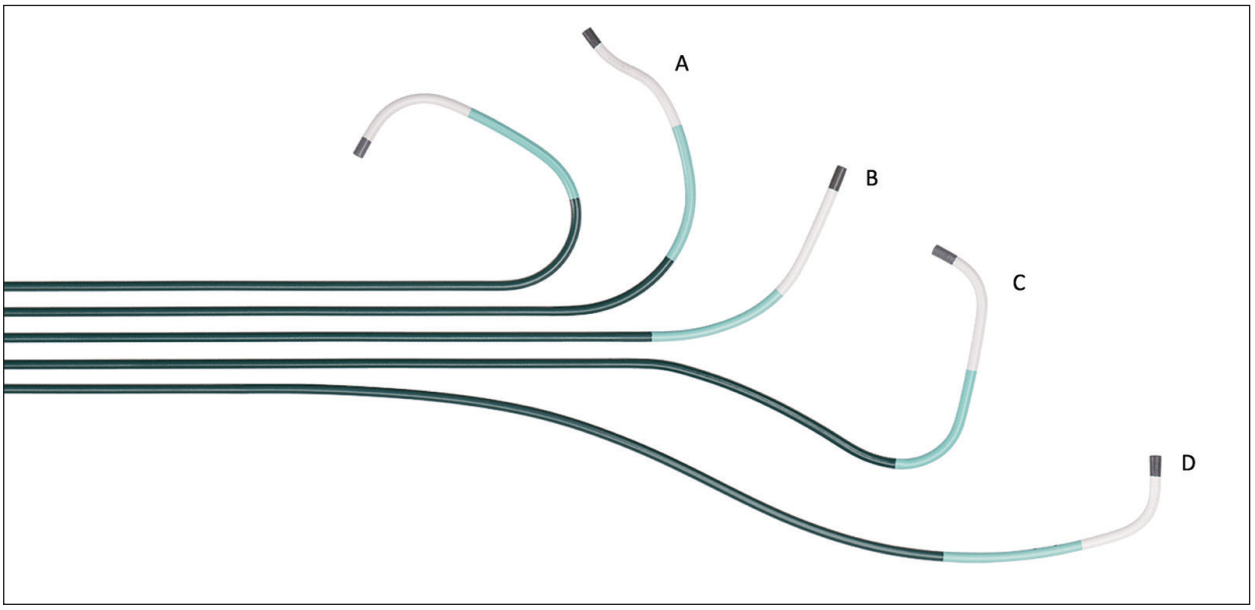
Guide catheters are stiffer, have higher kink resistance, and can provide additional support (Figure 1). Compared with conventional catheters, the ID is larger and can facilitate the delivery of larger equipment, such as antireflux devices and stents. Guide catheters provide significant support in the aorta; however, due to their construction, they are not designed for tortuous visceral vessel cannulation. They are best used as a support catheter in tortuous unfolded aortas or aortas with significant plaque and for delivery of larger devices. Assessing the anatomy before intervention may allow the interventional radiologist to make an informed decision as to which guide catheter to use, thus avoiding catheter exchanges where a diagnostic catheter lacks support for vessel selection.

If a patient has aortic ectasia or the aorta is unfolded, we recommend using a guide catheter with a 125-cm, 4-F multipurpose catheter through it (Figure 2). This allows for support in the aorta and cannulation of the visceral vessel origin. Subsequently, the 4-F diagnostic catheter can be advanced further into the vessel for additional support, and the microcatheter can then be advanced through the 4-F catheter. Using a diagnostic catheter in a guide catheter that is 1 F larger is called the "mother-child technique" (Figure 2). A 5-F guiding catheter has an approximate 0.057-inch ID (this may differ slightly with each manufacturer) and can accommodate all of the larger antireflux devices, including the Surefire antireflux device (TriSalus Life Sciences), Occlusafe balloon occlusion catheter (Terumo Europe), and Sniper balloon occlusion catheter (Emboly, Inc.).

Examples of guide catheters include Concierge (Merit Medical Systems, Inc.) and Launcher (Medtronic). This is not an exhaustive list, and all of the manufacturers in the coronary space produce guide catheters. It is important to note that most guide catheters are 100 cm in length, which limits their utility in general. The Launcher catheter is available in 110 cm, the Heartrail II guide catheter (Terumo Interventional Systems) is available in 120 cm, and the Vista Brite Tip catheter (Cordis, a Cardinal Health company) is available in 120 cm; however, these are by special order only, and they are only available in multipurpose and Judkins right 4 shapes.

TABLE 1. COMMON DIAGNOSTIC CATHETER SHAPES AND THEIR RESPECTIVE AVAILABLE LENGTHS

Catheter	Shape	Length	Vessel
Ultimate 1		100 cm	More suited to cardiology
		110 cm	Will reach visceral vessels in most women and shorter patients
		125 cm	Most versatile; will reach the distal visceral vessels
		135–150 cm	More suited to the pelvis and periphery; limits microcatheter use
Multipurpose		125 cm	Versatile; will reach all the visceral vessels
Berenstein/vertebral		125 cm	Versatile; will reach all the visceral vessels
		135–150 cm	More suited to the pelvis and periphery; limits microcatheter use



Courtesy of Merit Medical Systems, Inc.

Figure 1. Useful guide catheter shapes: Ultimate 2 (Merit Medical Systems, Inc.), a similar configuration to the Sarah and Jacky (A); multipurpose (B); Ultimate 1, a versatile catheter shape for all visceral interventions (C); Judkins right, similar to a Cobra catheter (D).

The recent addition of guide extensions (eg, Guidezilla II, Boston Scientific Corporation) can increase the guide catheter length by 25 to 40 cm, for a total working length of up to 140 cm. Guide extensions are hypotubes attached to a flat piece of metal that is 150 cm in length, and they are designed in 6- and 7-F options. The extension is inserted through a guide, preferably one that is 0.5 F larger than the extension, and it can be used to obtain more purchase in a target vessel. The devices are highly trackable and provide excellent support for coil procedures or antireflux device delivery, where support in the hepatic artery is required (Figure 3). In addition, they can be used for SIRT administration, where a single- or multiple-point administration is performed but removal of the catheter is not required. In these cases, the "hot catheter" combination can be disposed of and the guide catheter and Guidezilla can be left in place.

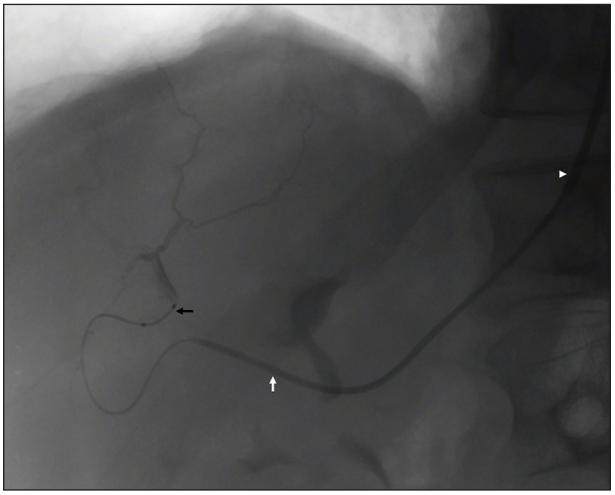


Figure 2. A hepatic angiogram demonstrating the mother-child technique. A 5-F Ultimate 1 guide catheter (arrowhead) with a 4-F, 125-cm multipurpose diagnostic catheter (white arrow) through it and an Occlusafe balloon (black arrow) deployed for a pressure-directed TACE.

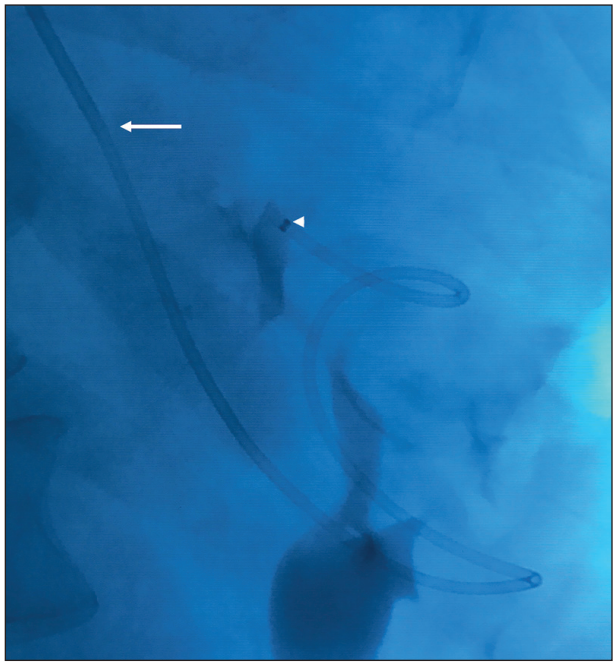


Figure 3. A 6.5-F Eucath (arrow) with a 25-cm Guidezilla II device through it, tracking through a tortuous hepatic artery. The distal tip has a radiopaque marker (arrowhead).

SHEATHLESS GUIDE CATHETERS

Sheathless guide catheters do not require a sheath for insertion. Their sizing corresponds to their OD, as is the standard with diagnostic and guide catheters. They can be used in lieu of a standard sheath and guide catheter combination (with a reduced OD) to facilitate device delivery. The lack of a sheath allows the operator to use a large-ID device without needing a larger sheath. The SheathLess Eucath and SheathLess PV catheters (Asahi Intecc USA, Inc.) are available in 100- and 120-cm lengths, respectively, with multipurpose, Judkins right, and Berenstein shapes available, depending on the size and length. The ODs range from 6.5 to 8.5 F. The ID of an 8.5-F sheathless guide is equivalent to that of a 6-F standard sheath. The 6.5 F has an OD equivalent to a 4.5-F vascular sheath, and the 7.5 F is equivalent to a 5.5-F OD vascular sheath. If sheathless guide catheters required a sheath, the sheath would be at least 0.5 F larger than the catheter (ie, 7-, 8-, and 9-F sheaths to accommodate the guide catheter).

Guide catheters have their own dilator that allows for insertion over a 0.035-inch wire. We suggest achieving radial access, advancing a standard diagnostic catheter into the distal thoracic aorta, and placing an exchange length wire of any kind to allow for passage of the sheathless system. A skin incision at the access site is required. In addition, the catheter does not have a radiopaque tip, which makes visualization challenging. However, this small omission should not detract from this invaluable device. The sheathless guide catheter can be used in place of a standard guide catheter if the radial artery size is prohibitive and larger devices, such as covered stents, are required. The 6.5-F guide can be used as an alternative to a 5-F guide if the radial artery is too small to accommodate a 5-F sheath. We recommend keeping these on the shelf, even in small numbers, because sheathless guides can often be helpful in challenging situations, particularly in an emergent cases of vessel perforation requiring a covered stent.

MICROCATHETERS

The choice of microcatheter is operator dependent, but lengths < 150 cm will limit the ability to obtain distal purchase, particularly if anything longer than a 110-cm diagnostic catheter will be needed. Usable catheter length is further limited by the hub of the diagnostic catheter and the hemostatic valve between the diagnostic and microcatheter. Because the base catheter is not used for injection in the majority of cases, there is little point in attaching a long hemostatic valve with a side arm for injection with this combination. In most cases where a 5-F diagnostic catheter and microcatheter are used, a short hemostatic valve with a controllable diaphragm for controlled pressure on the microcatheter is recommended (Flo 30, Merit Medical Systems, Inc.), particularly during pump injections. A hemostatic valve adaptor with a side arm is also recommended when using a guide catheter or sheathless guide catheter for injection around the catheter and the ability to flush the catheter is recommended; it is also recommended for use with a microcatheter or antireflux catheter. We believe that the longer Y-adapter valves (Tuohy-Borst; Copilot, Abbott; PHD, Merit Medical Systems, Inc.) are too long and decrease the usable length of the catheter within it. We use a shorter hemostatic valve adaptor with a side arm for injection, such as the Flo40XR device (Merit Medical Systems, Inc.).

Microcatheter lengths of 150 cm are almost always adequate for abdominal interventions. The choice of catheter ID depends on the procedure, and considerations such as the need for coils, embolic size, and snares will determine the microcatheter ID. There are many microcatheter options available for TACE or SIRT procedures where no coils should be used, including the 0.021-inch Direxion (Boston Scientific Corporation) and the 0.021-inch, 2.4-F Progreat (Terumo Interventional Systems). Small distal tip catheters such as the 0.022-inch, 1.98-F distal tip Masters Parkway (Asahi Intecc USA, Inc.) and the 0.016-inch, 1.7-F distal tip and 0.020-inch, 2-F distal tip Pursue microcatheters (Merit Medical Systems, Inc.) are suitable for pushable coil delivery or detachable coil delivery (Concerto, Medtronic).

However, caution should be taken with microcatheters that have a < 0.020-inch ID when coils are used. If smaller, more conformable coils are required for small vessels such as the right gastric artery, and a low-profile microcatheter such as the 1.7-F Pursue is used, then a 0.010-inch coil can be used (eg, Smart Coil, Penumbra, Inc.). If larger coils or pressure injections are required, high-flow microcatheters with larger IDs are recommended. A number of high-flow microcatheters are available, including the 0.027-inch Direxion Hi-Flo (Boston Scientific Corporation); the 0.027-inch, 2.9-F Maestro (Merit Medical Systems, Inc.); the 0.027-inch, 2.8-F Progreat; and the 0.025-inch, 2.6-F Velocity (Penumbra, Inc.) devices. A small selection of longer microcatheters are also available, such as the 0.025-inch, 2.6-F Velocity and the 0.027-inch, 3.2-F Marksman (Medtronic) devices, which are both 160 cm long. The 0.016-inch, 1.9-F Prowler 14 device (Codman Neuro [Johnson & Johnson]) is 170 cm long, but caution must be taken regarding the ID and the use of coil or liquid embolics.

ANTIREFLUX CATHETERS

There are three antireflux catheters available for use in oncologic procedures. The Surefire antireflux device requires a 0.056-inch ID for delivery; therefore, a 5-F guide catheter is essential for use with this product. The redesigned Surefire Precision device (TriSalus Life Sciences) has decreased the crossing profile and trackability. Finally, the newer Surefire Spark device (TriSalus Life Sciences) can be inserted through a diagnostic catheter with a 0.038-inch ID, provided the catheter does not taper to 0.035 inches at the tip.

The Occlusafe balloon occlusion catheter can be used with a 0.038-inch ID diagnostic catheter and is highly trackable.

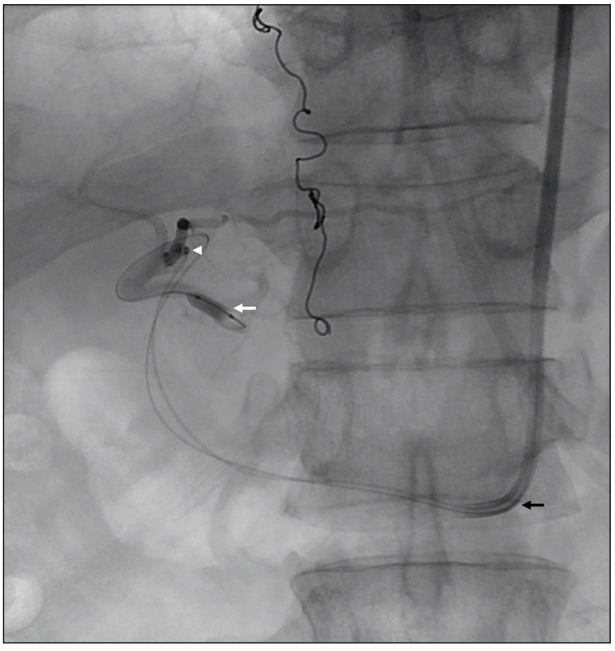


Figure 4. A 6.5-F Eucath (black arrow) placed in the origin of the common hepatic artery. A 3- X 9-mm NC Sprinter device (Medtronic) is inflated in the segment III artery for temporary occlusion during SIRT administration. SIRT administration is then performed through a Surefire Precision catheter (arrowhead) deployed in the left hepatic artery to treat segment II and IVa.

It has a 0.016-inch ID and requires a 0.014-inch wire. The balloon can occlude vessels up to 4 mm (Figure 2). The Sniper balloon occlusion catheter has a 2.2-F distal tip and a 0.020-inch ID, allowing up to 0.018-inch coil delivery and spherical particles up to 900 µm. It is compatible with dimethyl sulfoxide, glue, and Lipiodol (Guerbet LLC).

ADVANCED HEPATIC TECHNIQUES

For advanced hepatic intervention where temporary balloon occlusion or stenting is needed, guide catheters are required. In these cases, the operator needs to be familiar with the cardiology inventory in their practice. A variety of balloons and stents that are low profile and designed for use in the coronary space are available for hepatic procedures. The balloons are available in lengths as small as 9 mm, which allows them to track extremely well; many up to 5 mm in diameter are compatible with 5-F guide catheters (Figure 4).

If stenting is required, balloon-expandable stents on 150-cm shafts are mandatory. The stents are compatible with 6-F guide catheters, 4 to 7 mm in diameter, and made of cobalt chromium, which will not cause artifact on MRI. In the case of vessel perforation and the need for a covered stent, covered coronary stents are available on a 150-cm shaft (PK Papyrus, Biotronik). These stents are compatible with a 5-F guide catheter at 2.5 to 4 mm and compatible with 6-F guide catheter at 4.5 to 5 mm; they are highly conformable and trackable due to their low crossing profile, polyurethane membrane, and nontraditional stent design. The 3-mm stent has a crossing profile of 1.25 mm.

CONCLUSION

Detailed preprocedural planning is vital to ensure the appropriate equipment is available and selected for the intended intervention. Aim to use access equipment with the largest ID and smallest OD whenever possible to reduce vascular trauma and access site complications. Equipment delivery sheath requirements and delivery system lengths are important limiting factors for more complex interventions; therefore, a thorough knowledge of current departmental inventory is essential. Ensure that the equipment can fit through the radial artery and reach your desired target vessel. In the case of an unforeseen event, consider cardiology inventory in your hospital. ■

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