The Advantages of Universal Guiding Catheters for the Transradial Approach

Cath Lab Digest talks with Sandeep Nathan, MD, MSc, FACC, FSCAI, Associate Professor of Medicine, Medical Director, Cardiac Intensive Care Unit, Director, Interventional Cardiology Fellowship Program and Co-Director, Cardiac Catheterization Laboratory at the University of Chicago Medicine, Chicago, Illinois.

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Can you tell us about your practice?

I am an interventional cardiologist at the University of Chicago Medical Center, where I serve in administrative roles as co-director of the cardiac catheterization laboratories and medical director of the cardiac intensive care unit. I also serve as the director of the interventional cardiology fellowship program. My practice is fairly high-volume with a strong focus on coronary intervention, ranging from straightforward elective procedures to emergent cases to planned complex high-risk indicated procedure (CHIP) cases. I also do peripheral vascular intervention and some structural work, with a focus on transcatheter aortic valve replacement. I began the transradial program at the University of Chicago about 11 years ago, in 2008, shortly after starting here. It has since evolved into a lab-wide initiative where the majority of operators use the radial approach in a majority of cases. My partners and I, over the past decade or so, have transformed our lab into a radial-first lab. In that context, universal catheter use has become the default for many operators, including myself.

What defines a universal guiding catheter?

A universal catheter has a specialized curve or curves, usually meant for use from a right radial approach, recognizing the greater tortuosity and leveraging the increased contact points with the large vessels of the arm and the aorta in coming from a right radial (versus a left) radial approach. A universal catheter is meant to cannulate multiple vessels in a single use, whereas most femoral catheters are meant for a single, dedicated application, such as a catheter for the native left system, a catheter for the native right coronary artery, and different catheters for various types of bypass grafts. With a universal catheter, the expectation is that you will cannulate multiple vessels — often all vessels — with a single catheter, which allows for efficiencies during the procedure. More importantly, use of a universal guiding catheter from a radial approach minimizes the number of passes through the arm, and therefore the potential for irritating the vessel and precipitating radial spasm.

Is universal guiding catheter use unique to a particular access site?

Most operators would say that it is unique to the radial approach. There are catheters that you can potentially use from a femoral approach that would work in a universal capacity, but practically speaking, there are very few dedicated catheters for that purpose. Someone who feels comfortable using Amplatz catheters could potentially use an Amplatz catheter from the leg, but you have to be fairly skillful with Amplatz catheters to avoid traumatizing coronary ostia. If we look back in history, the original technique of selective coronary angiography involved the use of a single catheter, manipulated in the aortic root in order to cannulate multiple vessels. The current multipurpose catheter bears a resemblance to the original multipurpose catheters, but very few practicing interventionalists remember those days, let alone practice the technique, simply because dedicated catheters came into existence for cannulating different vessels, primarily from a transfemoral approach. Dedicated catheters have allowed operators even with a limited skill set to successfully and efficiently cannulate all of the vessels by utilizing multiple catheter curves. When our lab shifted to a radial-first approach, the initial reason for moving to a universal catheter wasn't so much to avoid excess time with multiple catheters, but to minimize the number of passes through the arm. I believe the failure of radial access is often related to certain, specific technical issues. First, the operator may have inadvertently found themselves in a branch, a recurrent vessel, or in an anomalous vessel, and the associated spasm and patient discomfort are often a cause for failure. Second, failure may result from the inability to find a catheter that cannulates properly from a right radial approach. The right radial is quite different from the femoral approach in terms of catheter manipulation, seating, and engagement. Specifically, finding backup is very different from a radial approach, whether it is left or right radial. In the United States, the majority of the time, a right radial approach is used versus the left radial. The distal radial approach has gained a lot of popularity (interestingly, through Twitter and other non-traditional electronic presentation formats) and has really taken on a life of its own. In high-volume Japanese labs, the distal radial approach, specifically the left distal radial approach, has become very commonplace. It is the default access point in many cases. In complex cases that require multiple guides, bi-radial access can be used. Occasionally, operators will opt for proximal or conventional radial plus ipsilateral distal radial in the same arm, utilizing "slender" or low-profile access techniques. However, conventional or proximal right radial is still the default for most labs in the U.S. doing radial. The left radial approach is appealing from the standpoint of catheter manipulation, but is quite unappealing from the standpoint of ergonomics for an operator leaning over a patient. A conventional left radial approach can be a backbreaker if you are working from the right side of the table.

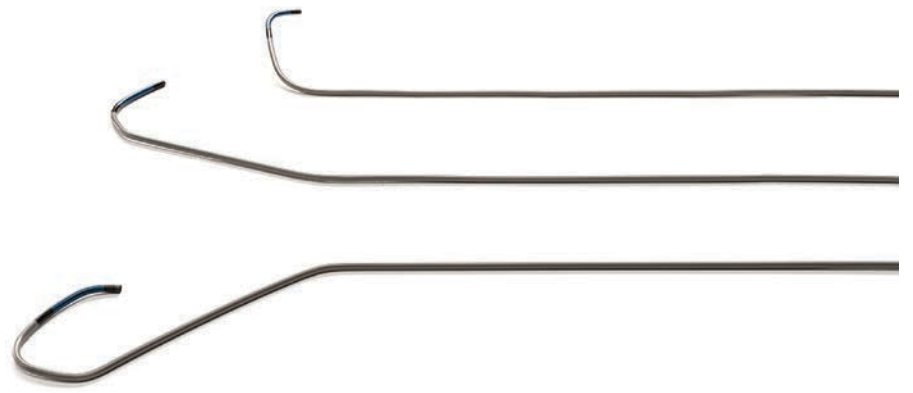

Figure 1. HEARTRAIL® Coronary Guiding Catheter.

What universal guiding catheter are you using?

The Heartrail series of guides with the Ikari curves are some of the most commonly used in our lab (Terumo Interventional Systems); most often, the Ikari left 3.5 or 3.75 left guiding catheter, which is a very unique catheter. We typically think about femoral guiding catheters with primary and secondary curves. The Ikari has at least three different curves. If you put it down on a flat surface, you can see that the tip lifts up slightly from the surface, meaning that the catheter itself is shaped in three dimensions. The Ikari catheter curves were designed in a bench model using load testing and maneuverability exercises, and capitalize not only on the angle of the brachiocephalic artery as it arises from the aorta, but also on what is known as the theta angle: the angle made by the body of the catheter engaged in the coronary artery and the opposite wall of the ascending aorta. These attributes are meant to increase the back wall support of the guide catheter when coming from a right radial approach. It maintains a nice balance between support and flexibility, and its surface is quite unique among catheters. While it has a braid or a skeleton inside it like every guide catheter (and some diagnostic catheters have braiding inside them as well), the texture of the braiding can't be felt from the surface. The surface of the Ikari catheter feels slicker than most guide catheters. While it does not have a true hydrophilic coating, it retains some of those tactile properties. The engineers who designed it created a micro-dimpled surface on the catheter that decreases drag. It effectively makes the surface feel slick using the same mechanism that allows a golf ball to derive lift: a dimpled surface. The dimples on a golf ball create air pockets that increase its lift through the air. The micro-dimpled surface of this catheter decreases friction by decreasing the contact surface as the catheter traverses arteries. I think it is a clever and innovative design that is more than just an engineering stunt; in my opinion, it really bears dividends when coming from a radial approach, where there is a great deal more contact between the catheter and the small-caliber vessels of the arm. Remember that the inner diameter of the radial artery is, on average, between 2 to 3 mm, which is not much larger than most guide catheters. When you add an element of vasomotor tone, i.e., spasm, then the amount of contact between the catheter and the vessel wall becomes much more relevant.

Do you always use a universal guide catheter when going from a right radial approach?

Disclosures: Dr. Nathan reports that he serves as a consultant to Terumo Interventional Systems, Merit Medical, and Medtronic, Inc.

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If I think there is anything that needs to be intervened upon or even needs physiologic assessment or intravascular imaging, I will start right out of the gate with a universal guide catheter. Universal catheter use obviates the need for catheter exchanges and I have the ability to do what is necessary with that single catheter, rather than fumbling around and crossing over a small fraction of a time to the leg or having the vessel lock up. Obviously there is a price difference between universal guide catheters (or any guide catheters) versus diagnostic catheters. The price differential is going to vary from catheter to catheter and lab to lab depending on contracting, but the dollar difference is not that much. At the end of the day, you are often using one universal guiding catheter versus two or three diagnostic catheters, and saving time in the process. If we look at a comprehensive cost model at our lab, one minute of lab time is associated with a quantifiable expenditure. Perhaps you are using diagnostic catheters and need a different shape or French size, but you don't have it in the room and someone has to go get it from your supply area. If you are idling for even a few minutes, you have likely eaten up the differential cost of just using a universal catheter right out of the gate. If you plan in advance for your case, in the sense that there is something you know you will need to fix or at least evaluate, there are operational efficiencies to be gained, in my opinion, by starting with a universal catheter right off, assuming you are comfortable doing so. One population at our institution that requires assessment every single year is the heart transplant population. By protocol, we do intravascular ultrasound (IVUS) of the proximal one-third to one-half of the left anterior descending coronary artery, and we compare it year after year to look for cardiac allograft vasculopathy, serving in many cases as a surrogate for low-level rejection of the graft and potentially prompting changes to their immunosuppressive regimen. We know that in these patients, even if the arteries look squeaky clean, they will undergo IVUS assessment. In these patients, I will start 100% of the time with a universal catheter if we are coming from a right radial approach, because there is no point in wasting the extra time. Since these are patients that need to have angiograms year after year, we will also rotate access sites: left versus right, proximal versus distal, in order to ensure that we are not repeatedly traumatizing the vessel in the same spot. Most people would say that a year is more than enough time to allow the vessel to heal, but intimal proliferation does occur in a radial vessel with each access, so we try to take the pressure off one access site by rotating. There is also the scenario where spasm occurs: heparin has been given, some pictures have been taken, and you go to put the catheter in, but the vessel spasms. Best-case scenario you are in a holding pattern for 5-10 minutes until the spasm releases. Worst-case scenario, you are stopping at that point, getting the ultrasound, and crossing over to contralateral radial or femoral access in a patient who is already anticoagulated. There are some downstream consequences if you guess wrong on the tolerance of the vessel for multiple catheter exchanges. When it is appropriate, I will start with a universal catheter to avoid some of these operational inefficiencies.

Is there a learning curve for universal guiding catheter use?

The Ikari guide catheters do, admittedly, have a learning curve, because these are deliberately designed catheters with some unfamiliar angles. This guide catheter is not meant to dive in and find the vessel on its own. Occasionally the catheter will get to the general vicinity of the coronary artery and with a little bit of torque on the catheter, it will pop in. Most times, however, you need to go down to the cusp in the ipsilateral sinus of Valsalva, and look up into the left main. You then approach the left main from an inferior to superior trajectory, roof the catheter in the left main, and pull it back to make it coaxial, and to optimize engagement and contact with the back wall of the aorta. Operators starting out with these catheters can sometimes become frustrated, because if they are coming from above and push, the natural inclination of that curve is to fold on itself. Operators will often equate catheter folding to incorrect sizing, but usually the sizing is fine; it is the manipulation that needs to be adjusted. Operators who approach the manipulation of this catheter with a "femoral approach sensibility" will need to adjust their expectations slightly, as that is not how this catheter engages. In all radial approach scenarios, there is more interplay between wire and catheter manipulation, and at times, patient maneuvers such as head-turn and deep inspiration. From a femoral approach, the catheter is advanced into the ascending aorta, aspirated, flushed, connected to pressure, and then pushed with minimal torque or special maneuvers. With universal guides, on the other hand, we will frequently attach a hemostatic valve to the back end of the catheter and have a wire going through it in order to adjust the angulation of the secondary curve. We will try it in its native configuration first and then alter the secondary curve, making the catheter straighter in order to engage different vessels. This, too, may feel a little unfamiliar. So while there is a learning curve, once you are comfortable, it certainly offers some advantages.

You mentioned economic benefits and time savings with universal guiding catheter use. What have you learned?

It is data we have considered formally collecting, but don't have on hand as yet. It stands to reason, though, that there may be potential for cost savings and it is based on our own observations. We have done estimates of procedure times with universal versus Judkins catheters, both used by experienced hands. Often procedure times are a few minutes shorter with universal catheters, especially in native anatomy. The reason to care about a few minutes is that one minute of cath lab time can be fairly expensive. While the actual number will vary from lab to lab, it is likely a lot more than you might expect if you include the cost of every single service being utilized (or not being utilized, as the case may be): nursing, technologist time, equipment, and so on. In the hybrid OR, it can be even more expensive, because there is OR staff, perfusion on standby, and it is a different type of case entirely that is being performed. We have become more mindful of these considerations as of late and in order to contain costs in the hybrid OR during TAVR cases, for example, we have stopped the routine practice of opening surgical trays unless the situation actually warrants it. We will have one in the room, but the minute you open up a tray, you have just burned through a serious amount of money, even if you don't touch anything. You have to re-autoclave all of those instruments at substantial cost. The cost of minutes wasted can be impressively high and ultimately, wasted time diminishes efficiency and throughput.

It makes sense to gain operational efficiencies by starting off with a universal guide catheter in many scenarios. For native coronaries, there is a 90%+ chance, in my experience, that the single catheter I start with is the catheter we complete the case with.

It's interesting to think about costs from the perspective of a minute of time.

As a lab director, I have to at least consider factors like how much time and what types of resources we are using for each case, the utilization rate and turnover time for each lab, and so on. The institution and our department are only compensated for those procedures we successfully complete. Per-unit time models don't really exist anymore in U.S. healthcare, but what if we asked ourselves, "If we open up the cath lab today and have zero business, how much money did we just spend to idle for a day?" It starts to add up. The natural extension of that is to ask how much money we expend on very mundane things, and on a minute-by-minute or hour-by-hour basis. It is obviously going to vary by cath lab, but the point is that it is many, many dollars, not pennies. If you shaved just 5 minutes off your case and can do so consistently, there is an argument to be made for low-cost technical solutions or iterative changes to your practice, if it can be done safely and effectively. It doesn't help if you go to a universal catheter, but you are taking non-selective aortic root injections because you are not comfortable or facile with its use. On the other hand, a universal guide catheter does help if you are facile with its use or using several additional catheters to adequately image and treat. We are a lab that practices evidence-based physiologic testing and intravascular imaging. The available medical evidence shows that patients do better if an intermediate lesion has a definitive number associated with it and the therapeutic decision stems from this number, rather than from a range of percentages based on angiography. In this environment, it makes sense to gain operational efficiencies by starting off with a universal guide catheter in many scenarios. For native coronaries, there is a 90%+ chance, in my experience, that the single catheter I start with is the catheter we complete the case with.

If a physician wants to get started with use of a universal guiding catheter, what is a good first step?

There are opportunities at most of the major interventional meetings to gain experience with universal catheters. Many of the medical simulators now incorporate universal catheters as a selection. When you are training on a simulator, it is important to manipulate an unfamiliar catheter with the goal of understanding not only how it succeeds, but also how it fails. There are also live courses where operators can understand, through case review and observation, how universal guiding catheters are most effectively used. Ultimately, you have to see some cases, and then get your hands on some catheters and try it yourself. That can be accomplished either solo, if you already have an established radial skill set, or by having proctors come in to guide you in completing a case with a single catheter. Depending on your comfort level and experience, there are many educational opportunities to help you rapidly improve your skill set. ■