

How Not to Evaluate and Treat the Immature AVF

Practical steps and tips for navigating the evaluation and treatment decisions for immature arteriovenous fistulas.

BY BART DOLMATCH, MD, FSIR

A typical interventional referral these days is the patient with an immature arteriovenous fistula (AVF)—one that is not ready for hemodialysis cannulation. Although there are many definitions of AVF immaturity, the problem is obvious when an AVF is 4 or 5 months old and is not yet being cannulated. The telltale sign of AVF immaturity is the persistent use of a tunneled double-lumen hemodialysis catheter despite the presence of an AVF.

Ultimately, the interventionist will perform a diagnostic angiogram of the arteriovenous circuit (*fistulagram*), but it's important not to start with an invasive study. That would actually be the last step. The first step, of course, is to obtain the patient's history. When was the fistula created? Could the patient feel a pulse or thrill, and if so, was there a time when the pulse or thrill was no longer appreciated? Maybe the AVF has been thrombosed for 1 to 2 months, and no intervention can salvage it. Perhaps someone has already tried to figure out why the AVF cannot be reliably cannulated and has performed imaging studies elsewhere.

PHYSICAL EXAMINATION

Should you do a fistulagram now? Not hardly! Take a few minutes to examine the AVF. I believe that there are four fundamental problems that result in AVF immaturity: (1) poor inflow, (2) some sort of anatomic problem in the cannulation segment, (3) outflow obstruction beyond the cannulation segment, and

Your physical exam should identify which type of problem(s) may be causing AVF immaturity and guide your approach to angiography and intervention.

(4) complete thrombosis of the vein. Of course, there can be more than one problem.

Physical exam has been shown to be as useful as diagnostic testing, and the examination of an AVF is not difficult to learn.¹ Is there a thrill, pulse, or bruit? If not, the fistula may be completely thrombosed. If you can feel a thrill, is it over the arteriovenous anastomosis, or is it displaced into the venous segment beyond the anastomosis due to juxta-anastomotic stenosis ("pseudo thrill")? Does the vein collapse easily (indicating an inflow obstruction or large upstream accessory veins), or is it too pulsatile (suggesting an outflow obstruction)? Does it make an unusual turn in the cannulation segment or seem to dive deep? Are there visible or engorged veins indicating partial occlusion of the cannulation segment or perhaps large accessory veins? Your physical exam should identify which type of problem(s) may be causing AVF immaturity and guide your approach to angiography and intervention.

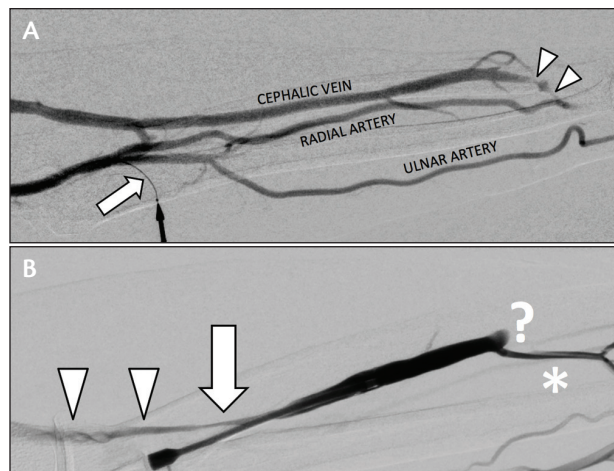


Figure 1. Fistulagram of an immature AVF using retrograde brachial artery injection through the cannula of a micro-puncture set (arrow; A). All arterial and venous anatomy is demonstrated. There is a juxta-anastomotic stenosis (arrow heads) that restricts inflow and causes AVF immaturity. The second image (B) shows the same AVF as (A), but studied the arteriovenous puncture after sheath insertion. The sheath caused spasm (arrow) with poor visualization of downstream anatomy (arrow heads). This venous segment was normal prior to venipuncture. Contrast could not be refluxed across the juxta-anastomotic stenosis (question mark) but preferentially filled a clinically insignificant accessory vein (asterisk).

ULTRASOUND STUDY

Ready for the fistulagram? Wait. Do not puncture that AVF until you've waved the magic wand over it. Magic wand? Yes, ultrasound. Once you have a reasonable idea about inflow or outflow obstruction, you can obtain additional diagnostic information by performing a 5-minute ultrasound survey when the patient is being prepped for the fistulagram. Your physical exam was pretty good for stenosis, but probably not so good for determining the diameter or depth of the vein. You may not appreciate large accessory veins in the juxta-anastomotic or cannulation segments. Don't go overboard with ultrasound, however. Color flow and Doppler exams take time and probably won't add much information at this point, so unless you're an ultrasound purist, forget on-table measurement of velocities and flow volumes. They're useful, but not essential.

FISTULAGRAM PUNCTURE

Now, onto the fistulagram. But don't puncture that vein! Although that's how many immature AVFs are studied, I think it's a mistake. For virtually every immature AVF that I've studied for the past 15 years, I've

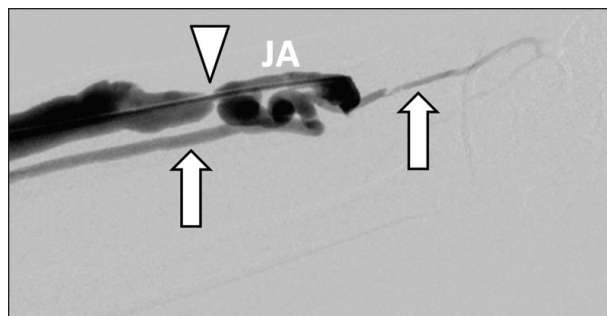


Figure 2. Retrograde venous catheter technique with reflux of contrast to visualize arterial inflow. Arrows point to a collateral venous circuit that was erroneously thought to be the radial artery. The inflow radial artery was actually no longer patent, and the AVF filled through the palmar arch by way of retrograde radial artery flow. The venous stenosis (arrow head) was balloon dilated, but the AVF had persistently poor flow due to the radial artery occlusion.

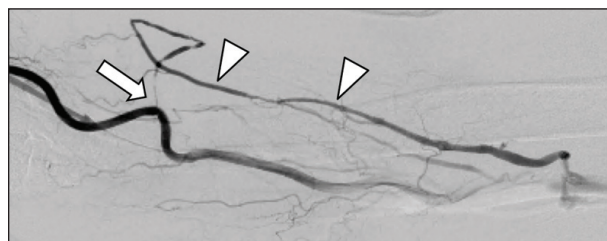


Figure 3. This 83-year-old woman with end-stage renal disease had a right brachiocephalic AVF created 4.5 months earlier. She was still using a catheter for hemodialysis. Her AVF could not be palpated. Ultrasound did not show an AVF. A fistulagram from the brachial artery revealed a tiny, serpentine AVF (arrow heads) that did not communicate with the cephalic vein. This AVF was abandoned.

used a retrograde brachial artery puncture with the inner cannula of a micropuncture set (Figure 1A). This allows a Seldinger puncture technique with over-the-wire placement of an approximately 3-F microcatheter directed upstream in the brachial artery. I connect short extension tubing to the microcatheter hub with a stopcock or flow switch on the end furthest away from the patient. I inject slightly diluted iodinated contrast (dilution reduces the viscosity) and routinely obtain terrific angiograms. Recently, this technique has been reported by Yan et al.²

Why inject from the brachial artery? Many reasons. First, you will not perturb the vein. Often, there is spasm in an immature vein at the puncture site. Spasm can simulate stenosis, exacerbate upstream accessory veins to make them seem significant, and confound evaluation of downstream outflow anatomy (Figure 1B). Additionally, you may not be able to reflux

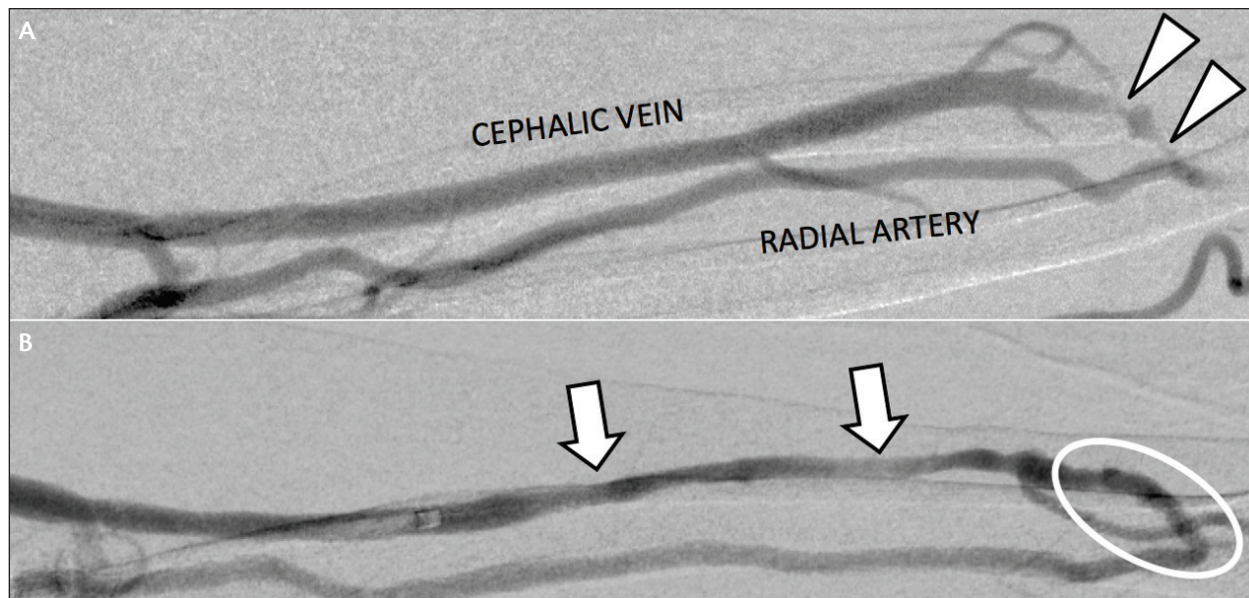


Figure 4. There is an inflow stenosis in the juxta-anastomotic segment (arrow heads; A). After treatment, the cannulation segment spasm (arrows; B), and the juxta-anastomotic angioplasty site was irregular (oval; B), but the physical exam was markedly improved. No further intervention was performed.

contrast back to the artery, especially if there is a significant upstream (juxta-anastomotic) stenosis. The flow velocity is just too great to get a good reflux shot across a juxta-anastomotic stenosis. Finally, you may not be able to evaluate the arterial side of the AVF when you reflux upstream from the vein. This can lead to misdiagnoses of arterial stenosis or occlusion such as an upstream radial artery occlusion (Figure 2). Brachial artery injection allows you to evaluate the entire AVF and can demonstrate even the smallest AVF that cannot be appreciated by physical exam or ultrasound (Figure 3). It's also a convenient way to perform repeated angiograms during intervention when you're working upstream from the venous side of the AVF.

TROUBLESHOOTING COMMON PROBLEMS

Ready to obtain a fistulagram? Sure, and once you've done your first run, perhaps you've found a problem that causes immaturity, such as a juxta-anastomotic stenosis. Ready to select an angioplasty balloon catheter? Wait! The guidelines mandate that you study the entire AVF—from the inflow artery to the right atrium. If you don't perform a complete study, you aren't meeting the accepted standards. Worse, you probably shouldn't get paid, as Medicare and other payers expect a complete exam. It's acceptable to obtain the remainder of the fistulagram after your intervention, but just don't forget.

Maybe you've found both a stenosis that causes immaturity and also an 80% subclavian vein stenosis. Do not treat that subclavian vein unless it's symptomatic. There is no clear association between central vein obstructions and AVF flow, so unless the patient has arm swelling, the stenosis is probably not clinically relevant—at least for now. Once you've improved flow, there may be some swelling. You've then got to determine if it warrants treatment. But that's an issue for another day.

You've found a stenosis. Angioplasty, right? Not so fast. Does the stenosis correlate with your exam? I've seen immature AVFs with cannulation segments that are too deep, yet they have excellent flow volumes despite a 50% outflow stenosis. The stenosis wasn't the cause of immaturity and shouldn't be treated. Furthermore, angioplasty of that stenosis will only reduce the chance of palpating the deep cannulation segment. Make sure that your exam, ultrasound survey, and angiographic findings all correlate before performing an intervention.

After angioplasty, you've got a better-looking but "shaggy" vein with some stenoses that are probably venospasm—not a perfect result (Figure 4). You're considering using a bigger balloon, stent, or maybe stent graft. Don't do it! You've been working in an immature vein, and even though things don't look perfect, they are better. You cannot tell the extent of spasm, nor if the vein will look better in an hour or a week. Use your physical exam

skills. If the AVF has an appropriate pulse and thrill, leave it alone; you should see that patient in your clinic in the next week or so, when you can determine if further intervention is needed. The goal is not a beautiful appearance, but a better-functioning AVF that can be cannulated. If you examine the AVF and it still seems problematic for cannulation, you have good reason to consider further intervention.

How about coil embolization of an accessory vein upstream from the cannulation segment? Don't do it! Backtrack to your ultrasound probe, use it to find the accessory vein, and then compress the vein while you palpate the intended venous cannulation segment. If ultrasound-guided compression of the accessory vein improves your ability to palpate the cannulation segment, the accessory vein is a problem and should be treated. But if compression of the accessory vein does not augment the pulse in the cannulation segment, do nothing.

You've compressed the accessory vein, and the cannulation segment plumped up and had a better pulse. Coil embolization time? Not for most of my patients. I use my ultrasound skills to determine the depth of the vein. If it is only 2 to 5 mm deep to the skin, consider on-table ligation (Figure 5). I locally anesthetize over the accessory vein about 1 cm to the side of its origin, make a 1-cm incision, dissect it out, confirm that I've got it by performing a single fistulagram from the brachial artery microcatheter, and then ligate it with non-absorbable suture. Close the incision with a subcutaneous 4-0 absorbable suture and apply a dab of topical skin glue. You should have occluded the accessory vein in 10 minutes. The cost for all supplies needed is under \$100, and the result is permanent without risk of coil migration, erosion, or venous thrombophlebitis. No ugly subcutaneous coil bumps, limited radiation exposure to everyone, and a cost savings to the health care payer.

CONCLUSION

Once it was easy: Immaturity led to a fistulagram, and a fistulagram led to angioplasty. Now it isn't so linear, and there are many diagnostic and therapeutic options that can be used to treat the immature AVF. It takes more thought, skill, and a bit more

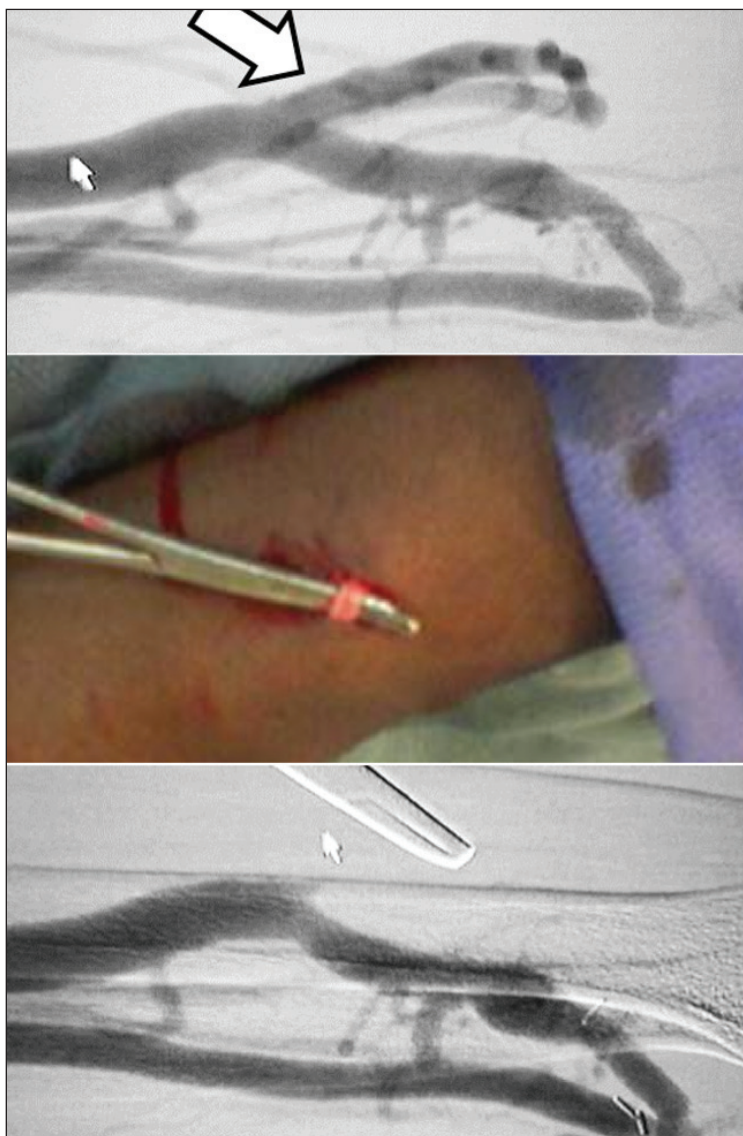


Figure 5. On-table ligation of an accessory vein.

time, and that's why I find evaluation and treatment of the immature AVF so rewarding. ■

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