

Best Practices for Successful Cannulation of Percutaneous AVF

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Recent advances in dialysis arteriovenous fistula creation have led to new options for hemodialysis patients. The creation of these fistulae using such devices as the Ellipsys Vascular Access System allows the creation of a dialysis fistula through percutaneous techniques. Such fistulae are designated as percutaneous arteriovenous fistulae (pAVF). They can be created quickly and safely in the outpatient setting. These fistulae can be created under conscious sedation or regional anesthesia without requiring general anesthesia and operating room time. They frequently require angiography and other maturation work subsequent to their creation but have so far led to higher maturation rates as compared to surgically created fistulae.^{1,2} They are typically cannulated in 6-8 weeks.

The Ellipsys device is used to create a fistula between the proximal radial artery and a perforating vein that connects the superficial and deep venous systems usually a few centimeters below the elbow crease (Figure 1). Blood flow is directed cephalad up the arm and can take many pathways that include the cephalic vein or in some cases the basilic or brachial veins (Figure 2). Ideally, the patient will have an adequate upper arm cephalic vein and procedures can be done if needed to direct most of the blood flow up the cephalic vein to essentially create an upper arm cephalic vein fistula. This is the preferred scenario as it allows the quickest time to cannulation without additional procedures and typically avoids vascular surgery. In some cases the basilic vein is the best vein and will typically need to be superficialized surgically.

One of the challenges with the percutaneous fistulae compared to a surgically created upper arm fistula is cannulation. This is for three reasons: 1. The

AVF is created with the inflow being the proximal radial artery as opposed to the brachial artery. This leads to a low-to-moderate flow fistula, that although has more than enough blood flow to support dialysis,

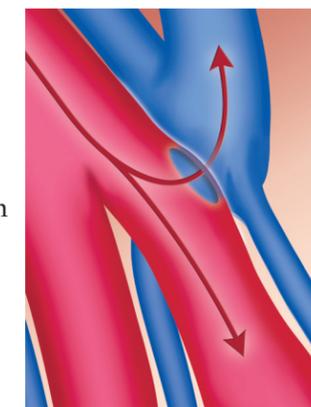


Figure 1. A fused anastomosis is created between the perforating vein and proximal radial artery resulting in AVF flow

may be difficult to localize. 2. The absence of surgical scars to use as landmarks can make localizing the fistula challenging. This is less of an issue if the fistula is a basilic vein fistula that has been surgically transposed. 3. Due to multiple outflow veins, simply occluding the fistula outflow with a finger may not distend the fistula sufficiently to cannulate.

Successful cannulation is best facilitated using a team approach. Everyone must do their part, from the interventional team to the dialysis center team with patient focus. It all starts with the vein mapping appointment.

Patient Education

Education starts when the patient is identified as a good candidate for pAVF. The target arm is identified and the patient is instructed on saving that arm for the dialysis access. From the time of the appointment there

should be no blood draws or blood pressures taken on that arm. Also the patient should be educated on not wearing clothes that fit too tight on the arm. All of these could change the patient's anatomy.

Post creation education consists of reminding the patient to continue to follow all of the precreation instructions. No blood draws and no blood pressures on the access arm. Tight fitting sleeves should be avoided. The patient should be advised against carrying anything that will lay across the access arm. The biggest culprit is stringing plastic grocery bags up the arm. At this point it is best practice to wear a wrist band on the access arm to serve as a reminder. Now that the access is in place, the patient should avoid sleeping on the access arm. This could occlude the vessels causing the access to clot. The patient should also be instructed on access assessment. The access should be assessed daily by palpation. Ideally the patient will have a stethoscope and instructed on its use to listen to the anastomosis.

Patient education also consists of what to expect when the time comes for the first use. They need to understand that their access is their lifeline and insist that best practice is being performed. The dialysis staff will assess the access—look, listen and feel. A tourniquet will be applied to the upper arm to aide cannulation. The patient also needs education on topical anesthesia, EMLA cream or Lidocaine. It is very important that the patient be educated about keeping the arm still during dialysis. They need to find a position that is comfortable yet still visible to the dialysis team. Prior to first use, the patient needs to be made aware the access must be cleared by the interventional team and the arm marked by the dialysis team.

Dialysis Team Education

Dialysis staff education consists of first identifying that the patient has a pAVF. The absence of surgical scars is the first clue. Best practice is for the interventional team to notify the dialysis center that a pAVF was created. The dialysis team needs to strictly follow new fistula protocol for their facility. After the access has been cleared for first use, the dialysis nurse needs to give the access arm a thorough assessment. If there is any question on the placement of dialysis

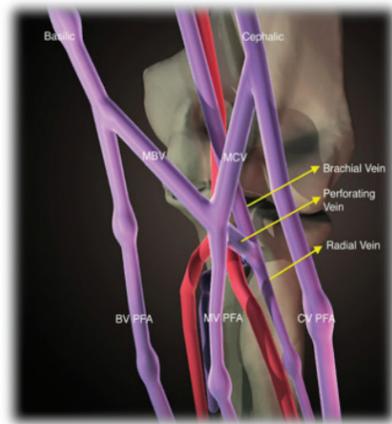


Figure 2. Venous and arterial structures in the antecubital fossa

needles, the patient should be sent to the interventional team to have the arm marked. Ideally this would be done when the pAVF was cleared for use by the interventional team, but could be done a day in advance.

There are two ways that we have marked an access. The first is to mark the borders of each side of the fistula. This creates two lines on the arm. We have found that this can sometimes be confusing to the dialysis staff. More so if the dialysis center does not see the patient until the next day. The second,

and what works best for us, is to mark the center of the fistula using ultrasound. The probe is moved up the arm and a dot is placed every centimeter (Figure 3). A line is drawn to connect the dots (Figure 4). We will also mark the best place to cannulate on that line. The pAVF will follow the “rule of sixes” to clear for first use. The access is 6mm in diameter, within 6mm from the surface of the skin and have a 6cm long segment for the cannulation zone.

Fistula protocol calls for always using a tourniquet to occlude the outflow to place needles. This is very important for a pAVF. The anastomosis is below the elbow using the perforator vein and the proximal radial artery. This access can have multiple veins that are draining (Figure 5). Using a finger to occlude the cephalic typically will not allow the fistula to engorge. The tourniquet will occlude any accessory veins, stabilizing the fistula and cause it to engorge to its largest size making it easier to palpate and place the needles.

Every facility will have their own new fistula protocol. These protocols were developed to ease the



Figure 3. Using ultrasound to identify the cephalic vein, a dot is placed every centimeter



Figure 4. A line is drawn connecting the dots

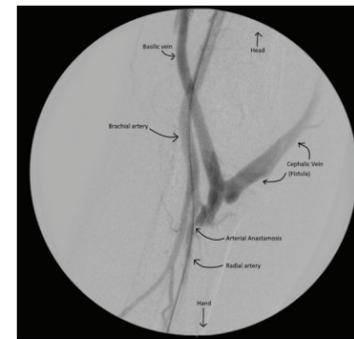


Figure 5. Fistulagram shows multiple outflows of pAVF

new fistula into use. Always make sure to familiarize yourself with this procedure. Typically this could mean starting off with a single 17g needle cannulation for the arterial flow and returning the blood to the catheter. This allows the patient to experience a cannulation and see how the vessel will react. Sometimes the vessel will spasm with the first cannulation.

The first two needle cannulation will start off with 17g needles and a low blood flow rate. Typical flow rate is 250ml/min. This will occur for three successful treatments before the needle size is advanced to 16g. The blood flow rate is increased with the larger needles to 300ml/min. Once again three successful treatments before advancing needle size or blood flow (Table 1). It is important to note that three treatments at a particular

| Needle gauge | Blood flow |
|--------------|------------|
| 17g | 250 ml/min |
| 16g | 300 ml/min |
| 15g | 350 ml/min |

Table 1. Needle size and corresponding flow rate

needle size is the minimum. Sometimes the patient does not tolerate moving up in needle size or flow rate. And that is okay. Using the access will help the new fistula mature faster. The key is not to rush it. Be sure to keep in mind that if the patient does have a CVC present, they are at an increased risk of infection and the CVC needs to be removed as soon as possible.

Summary

Any time the access is giving the team trouble call the interventional team for advice. This could be allowing the access to rest or sending the patient back for ultrasound of the access and marking the cannulation zone again.

The interventional team is very interested in the success of this new fistula. Engage in conversations and become familiar with pAVF (Figure 6). There are educational opportunities that could be offered to the dialysis team to help everyone have a great experience.



Figure 6. Communication between the dialysis team and interventional team is key

Key Takeaways

Interventional Team

- Patient education before and after pAVF
- All fistulae cleared by ultrasound for first use
- Provide educational offerings both on site and in-center
- Close communication with dialysis team

Dialysis Team

- Assess access every treatment post creation
- Ask for educational opportunities
- Always use a tourniquet and never use clamps
- Strictly follow new fistula protocol

Patient

- Protect the access arm before and after creation
- Ask questions
- Insist that protocols are followed (assessments, tourniquet and no clamps)
- If the dialysis team is having difficulty ask to be seen by the interventional team

References

- 2016 USRDS Report
- Hull JE, Jennings WC, Cooper RI, Waheed U, Schaefer ME, Narayan R. The Pivotal Multicenter Trial of Ultrasound-Guided Percutaneous Arteriovenous Fistula Creation For Hemodialysis Access. *JVIR* 2018 Feb.