Developed by: ANNA Specialty Practice Networks

Vascular Access Fact Sheet

Overview

Before beginning hemodialysis, patients must have a vascular access in place. The vascular access provides entry into the patient's bloodstream. The access allows the patient's blood to travel to the hemodialysis machine to remove toxins, wastes, and extra fluid before returning the blood back to the patient.

There are three types of vascular accesses: arteriovenous fistula (AVF), arteriovenous graft (AVG), and central venous catheter (CVC). Each access is created by a surgical procedure, although a temporary CVC may be inserted at the patient's bedside. Lok and colleagues (2020) advise a patient-centered approach to vascular access selection considering patient characteristics such as vasculature, overall health and life expectancy, expertise of the clinician, and consideration of potential future access needs based on the patient's long-term goals and preferences. Due to lower infection rates, an AVF or AVG is generally preferred over a CVC (Lok et al., 2020).

Arteriovenous Fistula (AVF)

An AVF is created surgically by connecting an artery and a vein and is usually placed in the arm. The traditional surgical procedure involves open surgical access to the vessels and remains the most common method for creating an AVF. Two catheter-based endovascular surgery methods for use in creation of the AVF were approved in 2018 (U.S. Food & Drug Administration, 2018). In one, which is usually placed in the upper arm, magnetic catheters are introduced into the proximal forearm and by means of radiofrequency energy, the access is created. In the second, a thermal resistance anastomosis device (TRAD) is utilized. After the TRAD is introduced, percutaneous balloon angioplasty and embolization are performed to complete the procedure. (Agarwal et al., 2019).

The AVF may be created in the lower arm, upper arm, thigh, or chest and may require a second procedure to superficialize the vessels which are too deep for cannulation. Maturation time varies from four weeks to one year, with a recent study showing up to one-third requiring intervention to assist with maturation (Huber et al., 2022; Woo & Lok, 2016). As the AVF matures, the vein will grow in diameter, and the walls will thicken from the blood flow of the artery. The AVF has historically been considered the best choice for those requiring hemodialysis, but recent studies show that there is no benefit to an AVF over an AVG in the older population (Lok et al, 2020; Robinson et al., 2021). Additionally, some patients may not be candidates for an AVF due to small or damaged veins or arteries or other medical conditions.

Arteriovenous Graft

The AVG is similar to an AVF but uses synthetic tubing material to connect an artery and vein. Transplanted animal or human vessels may be used as AVGs as well but are generally cannulated as if they are a fistula. The arm is the preferred site for an AVG, but the leg can also be used. Compared to AVFs, AVGs have higher rates of clotting and stenosis. However, they can be used sooner than an AVF (sometimes as soon as 2 weeks after placement) and rarely require a second surgery.

Caring for a Fistula or Graft

Good AVF or AVG care will help maintain the patency of the vascular access. Measures can be taken to prevent clotting or infection to the access. Patency is assessed by feeling the 'thrill' or vibration of blood through the access or using a stethoscope to listen to the 'bruit' or 'whoosh' of blood through the access. The patient should be encouraged to check the access for a thrill at least daily and report any change to their nephrology clinic or dialysis unit. Both the patient and the staff should monitor for signs of infection including pain, tenderness, drainage, swelling, or redness. At the first sign of infection, blood cultures are usually drawn and, in most cases, antibiotics initiated.

Before dialysis, the patients should wash their access in a prescribed manner. Prior to cannulation, the staff cleans the site according to facility protocol to prevent an infection.

The access needs to be protected from injury or restriction to prevent clotting of the access. Patients should be instructed to:

- Avoid tight clothing, jewelry, or pressure on the access area.
- Avoid carrying heavy objects across the access area.
- Avoid lying on the access site when sleeping.
- Not allow venipunctures or insertion of an intravenous (IV) line in the access extremity.
- Not allow blood pressure to be taken in the access arm.

Good needle insertion technique keeps the access working well. Arterial and venous needle tips should be at least 2 inches apart. Needles should not be placed near surgical scars or close to the anastomosis for endovascular AVFs. Examine the access to determine the location of previous needle sticks; this prevents damage to the blood supply to the blood vessel wall. Puncture sites should be at least one-quarter inch from previous sites.

Some facilities use the buttonhole technique for AVF cannulation. This method uses the same sites for each hemodialysis session. There is a specialized training program for the patient and healthcare provider before using this method. Direct pressure is applied to needle stick sites after each needle is removed. There are conflicting data surrounding an increased risk of infection and higher incidence of aneurysm formation using this technique (Vachharajani et al., 2020), and it is recommended primarily for those with limited AVF length, an enlarging aneurysm, and with failure of conventional rope-ladder cannulation (Lok et al., 2020).

Central Venous Catheter

A CVC is a narrow, flexible tube used to access the bloodstream. The CVC may be inserted into a large vein in the neck, chest, back, or groin. Two ports are at each end of the CVC exiting from the insertion site. One port allows blood to be removed from the body, and the other port allows blood to return into the bloodstream. CVCs are ready for immediate use after insertion.

There are tunneled and non-tunneled catheters. Sites preferred for tunneled catheter insertion are the right internal jugular or the right external jugular. Non-tunneled catheters should be used only when the patient is hospitalized. Prior to hospital discharge, a non-tunneled catheter should be replaced with a tunneled, cuffed catheter for patient safety.

It is recommended that tunneled, cuffed catheters are placed under fluoroscopy. This will confirm the catheter tip is in the right atrium of the heart. Non-cuffed catheters have a radio-opaque tip that when viewed on an X-ray, will show the position of the catheter tip at the junction of the superior vena cava and the right atrium of the heart. There must be documentation that the CVC is in the correct position before initiating hemodialysis.

Some patients use permanent CVCs, but this is not the recommended access for long-term dialysis in most patients. While CVCs have the advantage of being ready for use immediately after placement, CVCs:

- Have a greater chance of becoming infected or clotted.
- Have a slower blood flow, thus not adequately cleaning the blood.
- Are the least-preferred choice of access for long-term dialysis.
- Are at greater risk for central vein thrombosis or stenosis.
- Cause high risk for sepsis, hemorrhage, or air embolism.

However, there are situations when the CVC is the appropriate choice. These include short term:

- When a permanent access (AVG, AVF) is not ready for use.
- Acute episodes requiring immediate dialysis, i.e., transplant rejection.
- Peritoneal dialysis (PD) patient with temporary complication requiring PD rest.
- Transplant patient with a planned surgery date but who requires immediate dialysis.
- Complications with permanent access requiring access rest.

Long-term use of CVC may be indicated when there is:

- Exhaustion of access sites.
- Limited life expectancy.
- Patient preference (after being informed of risks).
- Venous insufficiency.
- Infants and children with inadequate vessels.

Central Venous Catheter Care

Patient care for the CVC is unit/organization specific. The most effective type of dressing remains unclear. The care team will need to evaluate patient factors (such as increased sweating) and environmental factors when deciding on an appropriate dressing (Pryor et al., 2022). There have been a few smaller pilot studies that have demonstrated no statistical difference in infection rates for people with a central venous catheter who wear a dressing versus those who do not (Ammar et al., 2019; Kosa et al., 2017; Lawrence et al., 2014), but this has not gained wide support in the nephrology community.

CVC ports must be always clamped when not in use. The ends of the CVC must have caps securely in place after each dialysis session. These measures will help decrease the chance of infection and will prevent air from entering the vascular system.

The exit site should be assessed at each dialysis session for signs of infection. The patient and healthcare provider should always wear masks during dressing changes and CVC access to prevent bacteria from the nose and/or mouth from contaminating the catheter or exit site. Hand hygiene should be performed, and clean gloves applied when performing CVC care. Staff must not pull or tug on the CVC. Scissors or other sharp objects should never be used near the CVC. If the patient presents with a fever, pain, swelling, exudate or tenderness at the catheter site, blood cultures should be drawn and often antibiotic initiated.

Blood draws from the CVC should be performed by nephrology nurses only; non-dialysis personnel should not be allowed to access the CVC unless there is a life-threatening condition or training by dialysis staff and competency validation are documented.

CVC adequacy may be positional, which means the patient may need to change position to get a better blood flow rate. If the CVC becomes dislodged, comes out, or bleeding occurs at the site, direct pressure should be applied to the INSERTION site, which is likely not the exit site, continuously for 20 minutes. If bleeding has not stopped after pressure, seek immediate medical attention. A catheter exchange is warranted for poor flow, pulling clots, or exposed cuffs.

Patients should be instructed to keep dressings dry and intact, avoiding swimming, showering, immersion in tubs or hot tubs. The patient will need to take care when bathing not get the exit site wet unless the unit has different protocol in place.

In addition to care of the vascular access, the registered nurse needs to collaborate with the other members of the healthcare team to formulate a vascular access team (advanced practice registered nurse [APRN], physician assistant, nephrologist, vascular surgeon, and dialysis technician) to assist in evaluating the vascular access for optimal dialysis access.

For the Advanced Practice Provider (APRN)

Additional recommendations for the APRN:

- Ensure the patient and supporting caregivers have had appropriate education related to modality choices and implement strategies to aid in selection of the best access for the individual with pre-emptive placement when possible (Lok et al., 2020).
- Educate the patient about “saving the vein” or vein preservation for future access creation, avoiding peripheral catheters and nonessential venipunctures if possible (Lok et al., 2020).
- Monitor the patient’s access by reviewing:
  - Dialysis laboratory values.
  - Dialysis adequacy.
  - Venous and arterial pressures.
  - Transonic flow rates or access flow rates.
  - Vascular access complications (ischemia, infection, bleeding, thrombosis, inadequate flows, aneurysm, steal syndrome, and high output syndrome).
  - The need for further use of catheter access (Gilliland, 2022; Inglese, 2022).
- Perform physical examination of access prior to cannulation if there are concerns about access function.
- Consider evaluation for hypercoagulable state if recurrent thrombosis of accesses.
- Order diagnostic tests (fistulogram/graftogram, duplex vascular scan of access) or laboratory values as appropriate.
- Have a plan of action for future dialysis access if the current access begins to fail or fails, including for people who perform peritoneal dialysis.

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