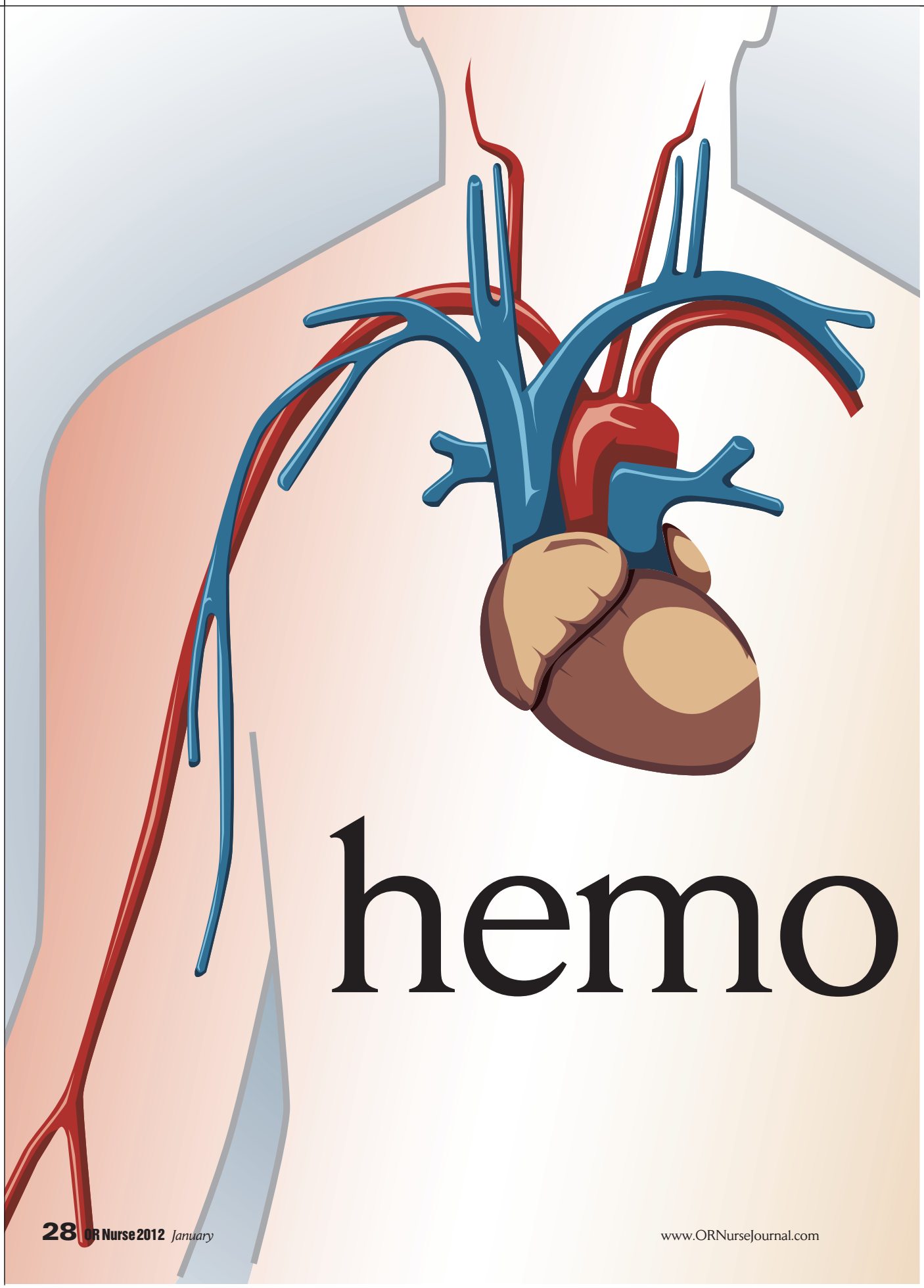

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Vascular access devices for dialysis

By Judith Carrion, EdD, MSHS, RN-BC, CRRN, CNOR

With the many available vascular access devices used for hemodialysis, perioperative nurses need to know the differences between them and how to care for patients with these devices.

Vascular access devices (VADs) for hemodialysis include arteriovenous (AV) fistulas, AV grafts, and central venous catheters (CVCs). These types of VADs often require surgery. The external AV shunt may be used for temporary vascular access,[1] but is now relatively uncommon as CVCs for hemodialysis are available for temporary access.[2]

The type of VAD used is determined by factors such as how long the patient will need dialysis and the course of a patient's kidney disease as well as the condition of the patient's vasculature. Often, patients have multiple accesses—for example, an AV fistula or graft that's maturing, and a CVC for immediate hemodialysis.[3]

AV fistulas

The AV fistula is the preferred long-term VAD for hemodialysis because it provides adequate blood flow, is durable, and has a lower complication rate than other types of access devices.[4] A fistula is an opening or connection between any two parts of the body that are usually separate, for example, a recto-vaginal (between the rectum and vagina) fistula. Most fistulas are an abnormal connection between an organ and another structure; however, an AV fistula is surgically created. An AV fistula requires advance planning because a fistula takes approximately 1 to 4 months after surgery to develop or mature.[4] A properly formed fistula is less likely than other kinds of vascular access to form clots or become infected.[4] In addition, properly formed fistulas tend to last many years longer than any other type of VAD.[3]

A surgeon creates an AV fistula by connecting an artery directly to a vein, usually in the nondominant forearm. Connecting the artery to the vein increases the blood flow into the vein. As a result, the vein grows larger and stronger, making repeated needle insertions for hemodialysis treatments easier. This surgery is generally performed under a local anesthetic and, in most cases, the procedure can be performed on an outpatient basis.[3] AV fistulas offer a better access patency and survival than a CVC or AV graft. AV fistulas have also been linked to better patient survival and have fewer complications (thrombosis, infec-

tion, or stenosis) compared to grafts or venous catheters.[4] However, if an AV fistula can't be created, an AV graft or CVC may be needed (see *AV fistula and AV graft*). Because an AV fistula has fewer complications, the Centers for Medicare and Medicaid Services set up an AV Fistula First Initiative with the goal of increasing the use of AV fistulas in dialysis patients.[5]

AV grafts

An AV graft is similar to a fistula, except that a synthetic vessel, commonly made of polytetrafluoroethylene (PTFE), is used to join the artery and the vein. Grafts are inserted when the patient's own vasculature doesn't permit a fistula. Benefits of an AV graft include more options for sites (usually the nondominant forearm, but the graft can be made quite long if necessary and can be placed in the thigh or upper arm) and faster maturation. A graft may be ready for use several weeks after formation.[2]

Complications of an AV graft include infection, stenosis, and thrombosis.[4] Stenosis can occur in the vein just below the area of the graft. Stenosis can also lead to clotting or thrombosis.

AV fistula and AV graft

Figure A shows an AV fistula created by anastomosing a patient's vein to an artery.

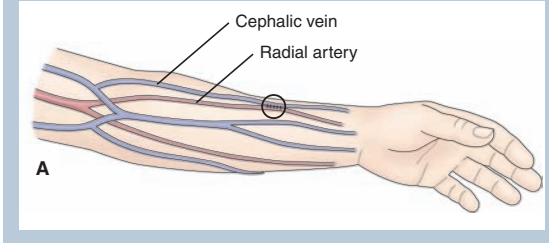
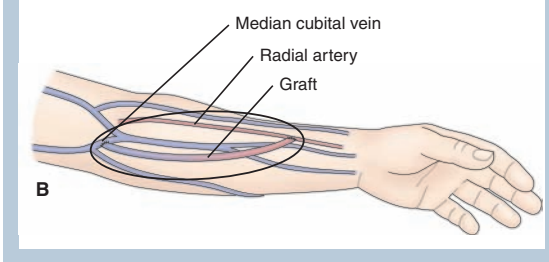


Figure B shows an AV graft created by placing synthetic tubing between the artery and vein.



Source: Smeltzer SC, Bare BG, Hinkle JL, Cheever KH. *Brunner & Suddarth's Textbook of Medical-Surgical Nursing*. 12th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010:1335.

CVCs

A CVC for hemodialysis is a temporary VAD used when immediate hemodialysis is needed. CVCs are effective for hemodialysis for several weeks or months while surgery is performed and an AV fistula matures. Catheters aren't recommended for permanent access because of the increased risk of thrombosis, infection, stenosis, or occlusion.[4]

A temporary, non-cuffed, double-lumen CVC is percutaneously inserted into a central vein, usually the internal jugular, subclavian, or femoral vein. Once a catheter is placed, needle insertion isn't necessary for hemodialysis. Two lumens in the catheter let blood flow in and out during dialysis. Long-term catheter access may be used in patients who haven't had success with fistula or graft surgery (see *CVCs for hemodialysis)*.The subclavian vein shouldn't be used for long-term access in patients with advanced kidney disease due to the risk of subclavian vein stenosis.[4,6] If the catheter will be used for more than 3 weeks, a tunneled, cuffed catheter is used to increase patient comfort and reduce complications.[1] The tip of the CVC must be confirmed by x-ray or fluoroscopy at the time of catheter placement.[4]

A recent development

An additional VAD that's recently come on the market is the Hemodialysis Reliable Outflow (HeRO) Graft.

The HeRO is used to maintain long-term access for patients with end-stage kidney disease on hemodialysis with venous outflow obstruction.

The HeRO has a combination AV graft component and a catheter-like outflow component with one anastomosis on the arterial (inflow) end. The venous end has a connector that attaches the graft to the outflow component.[2]

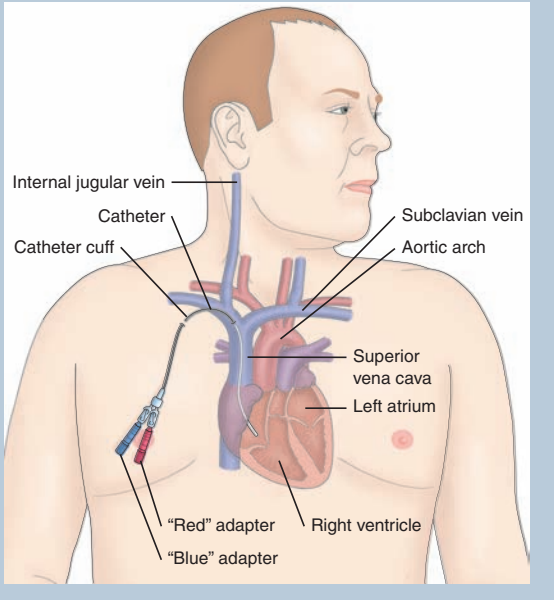
Patient assessment

Once the AV fistula or graft procedure is completed in the OR, the patient is transferred to the postanesthesia care unit (PACU). The following assessment steps should be followed in the PACU:

- Upon the patient's arrival from the OR, the nurse should validate with the surgeon that the patient has an audible, continuous bruit and palpable thrill of the AV fistula or graft.
- The nurse should confirm with the surgeon the acceptable parameters for the patient's systolic BP.
- The nurse should assess for patency of the VAD on

CVCs for hemodialysis

The illustration shows a double-lumen, cuffed hemodialysis catheter used in acute hemodialysis. The red adapter is attached to a blood line through which blood is pumped from the patient to the dialyzer. After the blood passes through the dialyzer, it returns to the patient through the blue adapter.



Source: Smeltzer SC, Bare BG, Hinkle JL, Cheever KH. *Brunner & Suddarth's Textbook of Medical-Surgical Nursing.* 12th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010:1335.

admission, every 30 minutes × 2, then every hour by listening for a continuous, low-pitched bruit over the access site with a stethoscope, and palpating for a thrill (pulsation) or "buzzing" sensation by lightly placing the hand at the distal anastomosis site.

The nurse should assess the operative extremity on admission every 30 minutes × 2, then every hour, and at discharge for: movement, sensation, temperature, capillary refill, presence of distal pulses, color changes, swelling/hematoma formation, and bleeding from the incision.

The nurse should report the following findings:
- Diminishing, absent, or a change in character of thrill or bruit
- Systolic BP outside of acceptable parameters
- A decrease in temperature, capillary refill, movement, sensation of operative extremity, or loss of signal by hand-held Doppler during pulse assessment
- Development of a hematoma or bleeding from the incision site
- Patient complaint of severe pain.

The following clinical pearls are helpful when caring for patients with an AV fistula or AV graft:
- Elevate the extremity on pillows to prevent edema.
- Don't use arm slings.
- Keep the extremity straight to prevent vessel constriction.
- Administer I.V. fluid therapy as ordered to maintain BP within prescribed parameters.
- Administer vasopressor medication I.V. as ordered to maintain BP within prescribed parameters.
- Keep the operative site within view until sensation returns if the AV fistula or AV graft is done under a nerve block.
- Document the insertion of the VAD, assessment findings, interventions, patient responses, and outcomes, and patient's and caregiver's level of understanding patient teaching (see *Patient teaching*).

Complications

Complications of VADs include thrombosis, stenosis, aneurysm formation, and infection.[1] Other complications that may develop include a possible pneumothorax or hemothorax with CVC insertion.

The most common problem resulting from VADs is thrombosis. Blood clots can form in temporary access catheters, fistulas, and grafts. Clotting can decrease or stop blood flow and make dialysis impossible. Clotted temporary catheters are injected with a fibrinolytic agent or are replaced.[6]

Clotting is a more common problem with grafts than with fistulas. It's important to examine the fistula or graft to determine adequate blood flow. Good blood flow is turbulent. The access site and peripheral pulses should be checked frequently. If the bruit or thrill has disappeared or a change is noted, the surgeon should be notified.[3,7]

Angioplasty may be required to treat stenosis of an AV fistula by widening the affected segment. Another option is to surgically replace the narrow segment.[7,8]

Aneurysms are another complication of fistulas and grafts that can form due to repeated needle punctures at the same site. A large aneurysm may cause the fistula or graft to lose function and require surgical repair.[1]

Because an infection is a complication of vascular access procedures, the AV fistula or AV graft site must be cleaned daily to prevent infection. The patient should be taught to clean the access site daily and instructed to report any signs of infection, such

Patient teaching[3,7]

After an AV fistula or AV graft procedure, patients and caregivers should be taught to:

- Protect the operative extremity for the first 2 hours after surgery by keeping it elevated, visible, straight, and unconstricted or uncompressed.
- Notify the nurse of any decrease in sensation or motion of the operative extremity.
- Avoid lying on the operative extremity when sleeping.
- Inform the nurse of increased swelling, pain, or incision changes.
- Avoid BP measurement, venipuncture, I.V. therapy, or arteriopuncture on the operative extremity.

as redness, swelling, pain, or tenderness at the AV fistula or graft site.

Should the CVC site become infected, the catheter must be promptly removed and the patient treated with the appropriate antibiotic. A new VAD will need to be inserted at another site.[7] To prevent infection when caring for a patient with a CVC, nurses should follow the CDC's *Guidelines for the Prevention of Intravascular Catheter-related Infections*.[6]

By understanding how and when these VADs are used, perioperative nurses will be better equipped to achieve optimal patient outcomes. **OR**

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