GORE-TEX® Vascular Grafts for Hemodialysis: Techniques for the Care and Cannulation of A-V Grafts
Sustained care of the hemodialysis patient demands the safe, efficient cannulation of the GORE-TEX Vascular Graft implanted as an arteriovenous (A-V) fistula. Much of the responsibility for the maintenance of adequate vascular access sites falls on the dialysis nurse/technician. Despite differences in individual patients and equipment, certain techniques of graft cannulation taken from the combined experiences of major dialysis centers have proven to be of benefit through the years. Consistent use of these techniques may aid in increasing the life expectancy of the A-V graft and improving the quality of life for the patient. In addition, cannulation may proceed faster, and with fewer problems, thereby contributing to the overall efficiency of the dialysis unit.
I. EVALUATING THE A-V GRAFT

HEALING PERIOD BEFORE CANNULATION

After surgical implantation of the GORE-TEX Vascular Graft as an A-V fistula, the physician may wait several weeks before allowing it to be punctured. Healing characteristics vary widely among patients but, within this time period, sufficient growth of tissue into the outer wall will have stabilized the graft. This is important in the prevention of both infection and hematoma.

In some cases, the physician may advise that the patient undergo hemodialysis before adequate healing can take place. An extremely cautious approach to these patients must be taken [see SECTION V]. Immediate or early cannulation should be considered only when there is no other alternative.

Once the patient’s graft has healed, inspection of the access site should be part of every hemodialysis session. Infections, hematomas, and pseudoaneurysms can present problems, making cannulation difficult, even dangerous. Early detection of such problems and prompt referral to the patient’s physician may save the graft and perhaps the patient’s life. The most serious complications are:

INFECTION
PSEUDOANEURYSM
HEMATOMA

INFECTION

Local swelling, redness, pain, and pus drainage are all signs of an access site infection. Should these or other suspicious symptoms be present, a physician should be notified immediately. Never insert a needle into the graft through an infected area. To do so is to introduce bacteria directly into the bloodstream. The chance of infection can be markedly reduced by rigorous adherence to aseptic technique [see SECTION II].
PSEUDOANEURYSM results from the repeated puncture of the graft at a single site. This results in a large hole in the wall of the graft and leads to loss of an area for puncture and perhaps a hematoma. The chance of infection and cloting of the graft is also greater.

HEMATOMA is the result of the unchecked bleeding from a graft puncture site. Blood spreads between the tissue and the graft wall, resulting in swelling and discoloration. Do not attempt to insert a needle through a hematoma. The needle will often clot, making it necessary to puncture the graft at a new site. This reduces the
available sites and complicates cannulation since pressure on the non-usable puncture must be maintained to prevent enlargement of the hematoma.

Prompt referral to a physician for removal and correction of the cause of the hematoma may be indicated, depending on the severity of the hematoma. Careful technique during and after cannulation will greatly reduce the number of hematomas [see SECTION III].

CHECKING THE FLOW IN THE GRAFT

Any time blood flow through the graft is reduced not only will blood removal be more difficult, but there is a chance that graft occlusion will occur. To check for adequate flow, palpate the entire length of the graft for a strong "thrill." A thrill feels like a consistent vibration under the skin and should be distinguished from the pulse. While a pulse may be present in a clotted graft, a thrill indicates sufficient blood flow.

If unable to palpate a thrill, listen with a stethoscope for the sound, or "bruit," made by the blood rushing through the graft. Changes in either the strength or nature of these two diagnostic procedures should be noted on the patient’s chart. Do not cannulate in the absence of either a thrill or a bruit.

Knowing the direction of the blood flow in the dialysis graft is also important. The venous needle should be placed in the direction of blood flow. This prevents recirculation and assists in the normal pattern of venous return. Ideally, the surgeon provides a diagram indicating the location of the graft and direction of blood flow. If a diagram is not available, you can determine flow direction with this simple technique.

Apply momentary pressure to the mid-point of the graft with your finger. Note the pulse in the graft. The side with the strongest pulsation is the direction from which blood enters the graft, the arterial side.

NEEDLE SELECTION

The needle with the smallest gauge that will achieve the required flow rate for the dialysis machine should be used. A needle with an ultrathin wall and a back eye can be useful in this regard. The length of the needle chosen may vary with the depth of the graft in the tissue. In most cases, a one-inch needle is adequate and helps reduce the chance of damaging the back wall of the graft. As a general guideline, always select the smallest, shortest needle adequate for the patient.
EVALUATING THE A-V GRAFT

A chart to map the position and date of puncture helps keep track of graft sites used and avoids “one-site-itis.” Puncture sites should be approximately one centimeter apart along the straight portion of the graft. Let two to three weeks elapse before puncturing closer than one centimeter from a previous site. Avoid punctures closer than three centimeters from where the graft is sewn to the artery or the vein.

The tightly curved portion of a loop graft should not be cannulated, because it is difficult to properly position the needle. External reinforcing rings, provided along this portion to help prevent kinking, may cause additional difficulties in cannulation.

II. ASEPTIC PREPARATION

Thorough aseptic preparation of the skin must be performed to reduce the chance of infecting the graft. Cannulation should be considered a surgical procedure with risks of contamination and infection. Dialysis staff may choose to wear sterile gloves, depending on procedures followed in their own dialysis centers. However, touching a disinfected needle puncture site with unprotected hands, non-sterile instruments, or dialysis equipment should be avoided.

Prepare the graft puncture site by using a topical antiseptic. Applying isopropyl alcohol prior to the antiseptic may aid in removing dirt and oils from the skin, but it is not effective as a disinfectant.

Apply the antiseptic in a circular motion away from the puncture site until a circle of two inches in diameter has been covered. Follow the antiseptic manufacturer’s instructions for effective disinfection. Local anesthesia may be injected prior to the final skin preparation, if necessary.
III. CANNULATION

TECHNIQUE

For dialysis using two needles, the arterial needle may be positioned either with, or against, the flow. However, less turbulence will result if the needle points in the direction of the flow. The venous (or return) needle must always be positioned with the flow. In single-needle dialysis, the needle must always point in the direction of flow.

Inspect the needle and make sure the clamp is in place on the cannula line. The skin at the puncture site may be pulled up and off the graft, or “tented,” so the needle will first pierce the skin [Figure 1].

![Figure 1](image1)

Usually the bevel of the needle faces upward and is introduced into the skin at an angle determined by graft configuration, location, and depth [Figure 2].

![Figure 2](image2)

Gently insert the needle through the graft wall while maintaining this angle [Figure 3].

![Figure 3](image3)

Holding the graft in place with the other hand may aid in accurately piercing the graft wall. Watch for blood flashback into the cannula. If the blood flashback does not appear or seems sluggish, verify the needle position by attempting to irrigate the needle and tubing with a syringe. A decrease or lack of blood flashback may occur because:

1. Bevel of the needle is pressed against the graft wall.
2. Needle is only partly in the graft lumen.
3. Needle has passed through the back wall of the graft.
4. Patient has low blood pressure.
5. Graft has low blood flow due to obstruction.

After confirming an adequate blood flashback, continue to insert the needle for no more than one-eighth of an inch to ensure the needle tip is positioned well inside the graft. Typically, the needle is rotated 180° so that the face of the bevel is directed downward [Figure 4].

![Figure 4](image4)
Some clinicians do not rotate the needle or rotate only if they have difficulty achieving adequate blood flow. Others prefer to cannulate with the bevel down. Insufficient data exist to support any of these methods. The choice of technique remains with the dialysis unit staff.

Next, move the needle shaft down so that it is close to the skin [Figure 5].

Continue to introduce the needle until it has been inserted up to the hub [Figure 6].

Rotating the needle and moving the shaft close to, and nearly parallel with, the skin surface may minimize the chance of puncturing the back wall of the graft during full insertion.

An angle of approximately 45° will create a flap in the graft wall at the puncture site. This may help minimize bleeding from the puncture site by forming a type of "valve" when the needle is withdrawn [Figure 7].

A needle entering the graft at a greater angle [Figure 8] would not create the desired flap [Figure 9].

Near parallel entry may damage the graft [Figure 10].
With experience, the dialysis nurse/technician will gain a precise “feel” for graft puncture. Please note that during all phases of needle insertion, care must be taken not to contaminate the disinfected area around the puncture site.

Investigate unusual resistance or pain occurring during cannulation. Once the needle is fully inserted and the wings taped, the patient should not experience discomfort. Persistent pain may indicate needle puncture of the back wall of the graft. In this condition, flow will often be sluggish and erratic upon aspiration. Low flow may also be the result of a clotted needle or an occluded graft. Correct such problems before continuing dialysis.

IV. AFTER DIALYSIS IS COMPLETED

Upon completion of dialysis, the needle should be carefully withdrawn and digital pressure applied to the wound to halt bleeding. Mild compression is more effective when applied to the area where the needle entered the graft, rather than where it entered the skin. Maintain light pressure with a cotton ball or folded gauze dressing over the site of graft puncture [Figure 11], until the bleeding stops.

Inspect the puncture site frequently for any external sign of abnormal bleeding.

There is a fine balance between enough pressure to prevent needle hole bleeding and excessive compression which may result in graft thrombosis. The decision to use adjustable arm clamps to control bleeding should be made on a patient-by-patient basis.

Indicate and date the needle puncture site on the patient’s chart.

Figure 11

This photo represents a properly punctured and well-healed needle entry site in the GORE-TEX Vascular Graft. Given sufficient time, fibrous tissue will grow into the puncture site to help maintain the integrity of the graft.
V. SPECIAL CONSIDERATIONS FOR EARLY CANNULATION

In selected cases, a physician may decide that a patient must undergo dialysis shortly after the vascular access graft has been implanted. Extra precautions must be taken with these patients because the danger of graft damage, hematoma formation, and infection is great.

Postoperative swelling may make it difficult to locate the graft and place the needles. A misplaced needle can damage the graft or puncture the back wall. Gentle digital pressure can be used to temporarily displace the swelling. This makes it easier to locate the graft by touch or by listening for the bruit with a stethoscope. A sketch by the surgeon can be extremely helpful in these cases.

Absolute adherence to aseptic technique is critical in early cannulation. It is advisable to wear sterile gloves since surgical incisions have not had sufficient time to heal adequately.

After dialysis is complete, pressure should be applied to the graft puncture site until the bleeding stops. The patient may not be able to provide sufficient pressure directly on the puncture site due to the swelling.

Certain dialysis units successfully employ the following practices for cannulation prior to tissue attachment:
- Local infiltration of lidocaine
- Graft movement prevented during cannulation
- Swift, clean puncture
- 17-gauge needles
- 200 mL/min blood flow for the entire dialysis session
- Low dose heparin

A LIST OF REMINDERS

1.) Inspect the access site for any complications
2.) Assess flow in the graft and determine its direction
3.) Select the smallest, shortest needle possible
4.) Rotate puncture sites every session
5.) Disinfect the chosen puncture site and do not touch again
6.) Insert the needle through the graft at an appropriate angle
7.) Minimize the chance of puncturing the back wall of the graft during insertion
8.) Evaluate the adequacy of the flow into and out of the needles
9.) Upon needle removal, mild non-occlusive pressure on the graft puncture site is needed until bleeding stops
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**DIALYSIS BIBLIOGRAPHY**