

Protocol for New AVF Cannulation

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Define successful cannulation

- Cannulation guidelines
 - New AVF
 - Mature AVF
 - Unsuccessful cannulations
- Detailed instructions for complications

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Successful First Cannulation of a New AVF

- A “New AVF Cannulation Protocol” should be developed by the entire healthcare team, including access surgeon and interventional nephrologist/radiologist
- Protocol should provide:
 - Clear instructions for the initial cannulation
 - Subsequent cannulations
 - Interventions for complications

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Cannulation of New Fistula Policy & Procedure

Purpose:

To successfully cannulate new arteriovenous fistulas and to prevent infiltration.

Policy:

Newly created primary AV fistulas shall be allowed to develop for at least 8-12 weeks prior to cannulation. Initial attempts to perform dialysis via new fistulas shall proceed with caution. Without exception, fistulas shall not be progressed faster than these guidelines **without MD order**. All patient care personnel are responsible for implementing this policy.

Procedure:

1. Obtain order from vascular surgeon or nephrologist to begin cannulation of fistula 8 to 12 weeks after creation. **All new fistulas should be examined by surgeon, nephrologist and designated staff member before cannulation is initiated.**
2. Only staff identified as demonstrating best cannulation practice techniques should be assigned to cannulate NEWLY developing fistulas.
3. **ALWAYS USE A TOURNIQUET**, even with well-developed fistulas. **NO EXCEPTIONS!**
4. Explain procedure to patient.
5. Educate patient on:
 - Checking the access daily for a thrill and for signs and symptoms of infection.
 - Performing fistula exercises to promote maturation process.
 - Understanding that hematoma could occur most likely during the first two weeks of using the access.
 - For infiltrations, provide written materials about icing, elevation, and heat application.

See FistulaFirst.org for entire Policy & Procedure.

- Check with charge nurse for heparinization changes. Heparin prime and hourly should be decreased by half of the ordered dose for the first week to prevent bleeding into the surrounding tissue. It may be necessary to initiate saline flushes during this week of

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National Vascular Access Improvement Initiative Web site.
Available at: www.fistulafirst.org. Accessed April 21, 2006.

Implementing a Unit-Specific Protocol for “New AVF Cannulation”

- Define:
 - Successful cannulation
 - Documentation guidelines for all cannulation procedures
 - Unsuccessful cannulation
- Detail instructions to follow for any anticipated complications for both staff and patients
 - Example: If an infiltration occurs on first attempt, should a second attempt be made... and when?

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Basic Requirements for Cannulation

- Must have:
 - Physician’s order to cannulate
 - Experienced, qualified staff person who is successful with new fistula cannulations
 - Use of a tourniquet or some form of vessel-engorgement technique (eg, staff or patient compressing the vein)

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Available at: www.fistulafirst.org. Accessed April 21, 2006.

Preliminary Considerations

- Reduce the patient’s fear of the initial cannulation
 - Words alone can either cause or reduce fear, so choose your words wisely! (Don’t use words like “stick” or “puncture.”)
- May need to adjust dialysis time to avoid rushing by the staff (eg, midweek or midshift treatments might be best)

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Preliminary Considerations (cont’d)

- Ask physician if heparin dose should be modified
- Use 17-gauge needles initially
- Use saline-filled fistula needles with syringes attached (optional)
- Use a tourniquet

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Needle Selection

- If patient has a catheter, use 1 lumen of the catheter and 1 needle in the fistula
- When using 1 needle for first cannulation of the AVF, which needle should you use?
 - Arterial needle?
 - Venous needle?

ANSWER:

(Arterial needle)

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Arterial Needle: First Use

- Arterial needle in the AVF, at least for the first use
- Rationale:
- If an infiltration occurs, blood is not being forced back into the needle via the blood pump = smaller hematoma
 - Also, permits pre-pump arterial pressure (AP) monitoring, which will help to determine if the fistula has a good access flow. The pre-pump AP should be ≤ -250 mm Hg at a 200 blood flow rate (BFR) with a 17-gauge needle. Excessively negative pre-pump AP = poor AVF inflow
- Thus, lower risk of complications with arterial needle used as the first needle

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National Vascular Access Improvement Initiative Web site.
Available at: www.fistulafirst.org. Accessed April 21, 2006.

Recommended Use of a Cannulator Rating System

- Cannulation knowledge and skill requirements integrated into a competency-based assessment template for use in staff learning and evaluation
- Enhance continuing education and training of dialysis staff
- Improve patient outcomes through 2 principal means:
 - Reduced hospitalizations
 - Fewer access complications

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Cannulator Rating System

- Level 1: New employee with no experience
- Level 2: New employee with experience
- Level 3: Current employee improving competency
- Level 4: Most experienced, competent cannulator

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Preliminary Steps

- Reduce patient fears
 - Choose your words carefully
 - Adjust dialysis schedule
- Educate patients
 - What they may feel during procedure
 - Report symptoms of complications
- Consult nephrologist concerning heparin dose modification when initiating AVF use

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Needle Selection

- Arterial needle for new AVF
- Rationale
 - Smaller hematoma if infiltration occurs
- Arterial needle permits pre-pump AP monitoring to evaluate blood flow
- Pre-pump AP ≤ -250 mm Hg at 200 mL/min (BFR) with a 17-gauge needle

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National Kidney Foundation. *Am J Kidney Dis.* 2006;48(suppl 1):S1-S322.

Clinical Clarification

Pre-pump arterial pressure:

- is the pressure exerted by the blood pump on the blood in the tubing segment between the access and the blood pump (pre-pump segment)
- is negative because the pump creates a vacuum that “pulls” blood from the access
- should be monitored at all times and not be permitted to become more negative than -250

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Determine Direction of Access Flow

Check Direction of Flow by:

- Looking
 - Inspect access for incisions/location of anastomosis
- Feeling
 - Palpate access
 - Gently compress access midpoint
 - Arterial inflow will “pulse with flow”
 - Venous outflow will have diminished or no pulse
- Listening
 - Auscultate access
 - Gently compress access midpoint
 - Arterial inflow will have pulsatile sound
 - Venous outflow will have minimal or no sound

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Needle Gauge

- 17-gauge needle is strongly recommended for initial cannulation
- A fistula may appear and feel ready to cannulate, but the vessel wall may still be fragile and unable to tolerate the needle puncture
- The smaller needle gauge helps to decrease injury to the vessel and prevents a large infiltration, hematoma, compression of the vessel, and possible clotting of the AVF should any cannulation complication occur (ie, infiltration)

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Adequacy of Needle Length

- Standard AVF needles are 1" long and are routinely inserted into the needle hub
- Shallow new AVFs may benefit from shorter needles
- Shorter, 3/5" AVF needles may advance fully into the shallow fistula

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Adequacy of Needle Gauge

- Compare needle with fistula
- Use 3/5" needle for shallow AVF

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Matching Needle Gauge to the Prescribed BFR

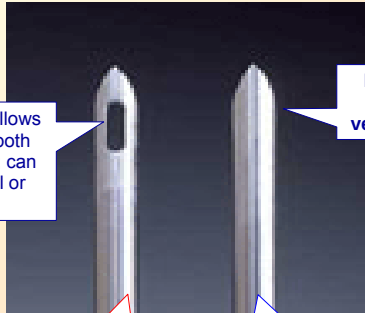
- Smaller needle gauge requires lower blood flow rates (BFRs)
- Needle gauge may be a specific physician order
- General needle gauge guidelines and maximum BFR with the pre-pump AP ≤ -200 to -250 mm Hg
 - 17-gauge needle = 200–250 BFR
 - 16-gauge needle = 250–350 BFR
 - 15-gauge needle = 350–450 BFR
 - 14-gauge needle = > 450 BFR
- Must monitor pre-pump AP to prevent excessive negative pressure from the blood pump drawing on the vascular access. Pre-pump AP should be ≤ -250 mm Hg for all needle gauges and BFRs

**Follow your unit-specific nursing policy and procedure for specific needle gauge and maximum BFR.*

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Use Back-Eye Needles

Back-eye opening allows blood intake from both sides of the needle; can be used as arterial or venous needle



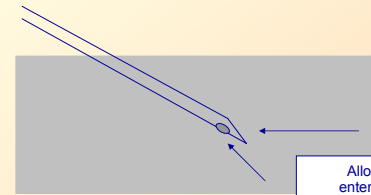
Non-back-eye needle—for venous use only

Arterial needle

Venous needle

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Back-Eye Needle Flow



Allows blood to enter or exit from both the bevel and back-eye

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Determining Direction of Access Flow

- Locate anastomosis
- Palpate
 - Arterial inflow “pulses with flow”
 - Venous outflow = diminished or no pulse
- Auscultate
 - Arterial inflow = pulsatile sound
 - Venous outflow = minimal or no sound

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Adequacy of Needle Gauge

- Once the AVF is established, to ensure the needle gauge used is correct, perform the following check:
 - Examine vessel size
 - How does it compare to needle size?
 - Compare size with and without tourniquet
 - Determine if the vessel diameter is adequate to accept the prescribed needle gauge

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Catheters: Flushing and Heparinization

If a catheter is in place:

- Consider any required adjustments to the heparin dose and timing for systemic heparinization (bolus, hourly, and end-time of hourly infusion) to prevent excess bleeding
- Consider the procedure for flushing and heparin locking the catheter lumens pre- and post-hemodialysis treatment to prevent excessive bleeding

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Patient Education

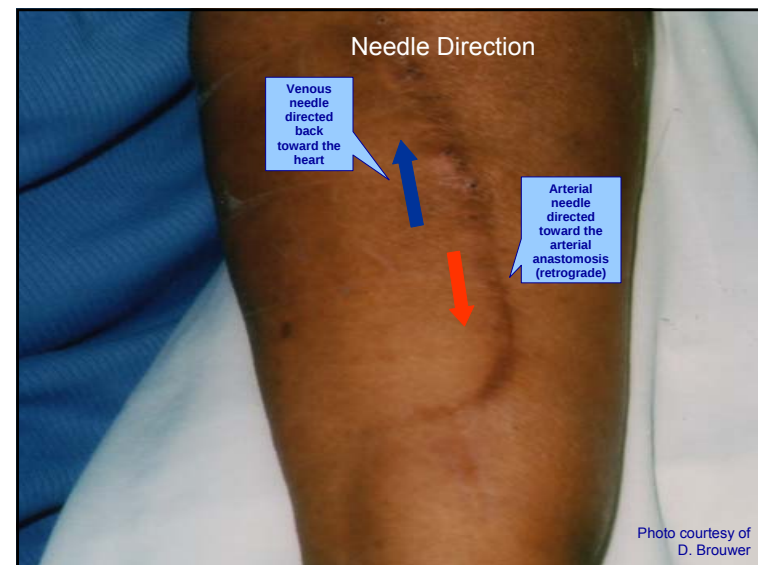
- Inform patients of what they may feel during the initial cannulation procedure
- Ask patients to report immediately any symptoms of any procedure complications (eg, pain, bleeding)
- Consider developing a teaching handout for patients' first cannulation experience (address pre- and post-first cannulation concerns)

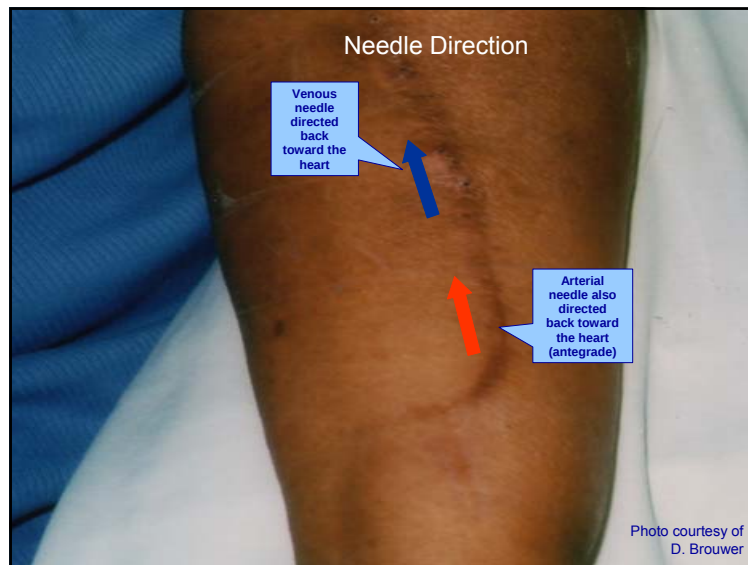
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Needle Direction

- Always cannulate the venous needle with the direction of the blood flow
- Always cannulate the arterial needle cannulation toward the blood inflow or with the blood outflow

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New AVF Cannulation Protocol

- Always use a tourniquet, regardless of the size or appearance of vessel
 - Use of the tourniquet helps to engorge, visualize, palpate, and stabilize the AVF
 - Use 20–35° angle for needle insertion for an AVF

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Consider Optional Use of “Wet” Needles

- Prime the fistula needle with normal saline solution (NSS) and leave a 10-cc syringe attached to the needle
- Check/aspirate for blood return
- Then flush carefully with NSS to check for any evidence of infiltration (with and without the tourniquet constricting the AVF)

Rationale: Since blood return alone is not enough to show good needle placement, flushing with NSS will be less traumatic than flushing with blood, should an infiltration occur

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National Kidney Foundation. *Am J Kidney Dis.* 2006;48(suppl 1):S1-S322.

“Wet” Needle



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When to Advance to 2 Needles

- Only after the arterial needle functions without:
 - Infiltration or hematoma
 - Cannulation difficulties
 - Access blood flow problems
 - Excessively negative pre-pump arterial pressures
 - Bleeding around the needle during dialysis
 - Prolonged bleeding post-dialysis
- At least 3–6 treatments tolerating one 17-gauge needle for arterial inflow

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Clinical Clarification

- Whether a clinician advances to 2 needles after 3 or 6 successful cannulations depends on his or her experience, clinical judgment, and the patient's needs.

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Advancing Needle Gauge

- Use same criteria
- Needle gauge in physician's order
- Match the needle gauge to hemodialysis blood flow rate

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When to Advance Needle Gauge

- When both fistula needles function for at least 3–6 hemodialysis treatments at prescribed blood flow rate (BFR) and needle gauge without:
 - Infiltration or hematoma
 - Cannulation difficulties
 - Access blood flow problems
 - Excessively negative pre-pump arterial pressures
 - Excessive venous pressures
 - Bleeding around the needle during dialysis
 - Prolonged post-dialysis bleeding

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Match Needle Gauge to Blood Flow Rate (BFR)

Needle Gauge	Maximum BFR
17-gauge	< 300 mL/min
16-gauge	300-350 mL/min
15-gauge	350-450 mL/min
14-gauge	> 450 mL/min

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Needle Gauge

- Smaller needle gauge requires lower BFRs
- Needle gauge may be a specific physician order
- General needle gauge guidelines and maximum BFR with the pre-pump AP ≤ -200 to -250 mm Hg
 - 17-gauge needle = 200–250 BFR
 - 16-gauge needle = 250–350 BFR
 - 15-gauge needle = 350–450 BFR
 - 14-gauge needle = > 450 BFR
- Must monitor pre-pump AP to prevent excessive negative pressure from the blood pump from drawing on the vascular access. Pre-pump AP should be ≤ -250 mm Hg for all needle gauges and BFRs

**Follow your unit-specific nursing policy and procedure for specific needle gauge and maximum BFR.*

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Arterial and Venous Pressure Monitoring and Limits

- A must, especially for a new fistula
- Pre-pump arterial pressure (AP) must be less negative than -250 mm Hg
- Venous pressure (VP) should not exceed the BFR with a 17-gauge needle
Example: At BFR of 200 mL/min, VP should not exceed 200 mm Hg
- Follow unit-specific processes and procedures for needle gauge and maximum BFR

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National Kidney Foundation. *Am J Kidney Dis.* 2006;48(suppl 1):S1-S322.

Understanding Pre-pump APs

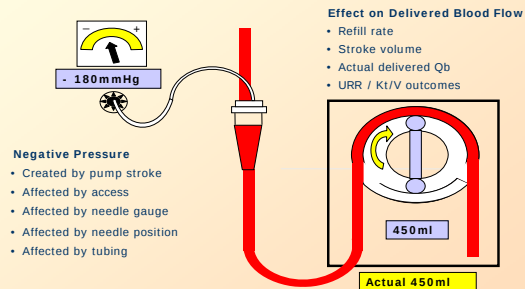
- Measures pull exerted on needle and fistula by blood pump
- AP exceeding -250 mm Hg
 - Significant drop in delivered blood flow
 - Hemolysis

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National Kidney Foundation. *Am J Kidney Dis.* 2006;48(suppl 1):S1-S322.

Pre-pump Arterial Monitoring

Normal Range*

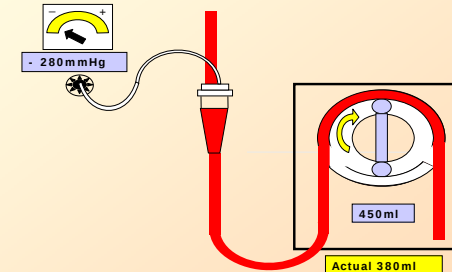


*Shows the effect of a normal pre-pump arterial pressure on delivered flow

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Pre-pump Arterial Monitoring

Excessively negative pre-pump arterial pressure*



*Shows the effect of an excessively negative pre-pump arterial pressure on delivered flow (ie, reduction)

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WARNING!

- Do not disarm the AP monitor, and always check to be sure that the pressure transducer is not wet and is functioning.

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Fistula First, National Vascular Access Improvement Initiative. Available at: www.fistulafirst.org/tools.htm. Accessed January 11, 2007.

Clinical Clarification

- Anything that makes it difficult for the pump to “pull” blood from the access will make the pre-pump AP excessively negative.

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What Causes the Pre-Pump AP to Be Too Negative?

- Increasingly negative pre-pump AP indicates insufficient blood inflow for the blood pump BFR
- Excessively negative pre-pump AP can be caused by anything that restricts arterial inflow to the blood pump:
 - Inadequate blood flow from the access
 - Needle gauge too small for prescribed BFR (ie, needle gauge "mismatch")
 - Obstructed needle
 - Obstructed or kinked line (a kinked arterial blood line can cause life-threatening hemolysis)

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Actual Blood Flow Rate Decreases as Pre-Pump AP Becomes More Negative

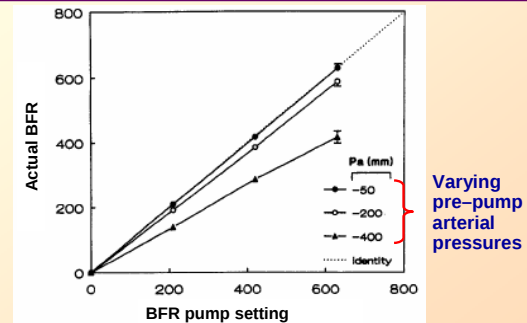


Figure 2. Subatmospheric blood inlet pressure (Pa) caused a proportional decrease in blood flow. Qb:RPM is whole blood flow displayed by the blood pump meter; Qb:volumetric is measured pump output *in vitro*. Pa is pump inlet pressure in mm Hg (torr). Data are shown $\pm$ 2 SD. When not shown, SD was too small to plot.

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Depner TA, et al. *ASAIO Trans.* 1990;36:M456-M459.

Clinical Clarification

- The danger of excessively negative pre-pump AP is that it causes a reduction in actual delivered blood flow, and also can cause hemolysis (destruction of red blood cells).

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What Actions Should Be Taken if Pre-Pump AP Is Too Negative?

- Increasingly negative pre-pump AP indicates insufficient blood inflow to meet the blood pump BFR demand
 - Larger-gauge needles may be needed for higher BFR settings
 - Check to make sure that needle is not obstructed or that blood line is not kinked
 - Blood pump speed as prescribed may not be attainable and may need to be reduced if/until cause is identified and remedied
 - Notify physician that access flow is not sufficient
- If pre-pump negative pressure is extreme (≥ -300 mm Hg), or rises rapidly during dialysis, act quickly; reduce blood pump speed until pressure falls into acceptable range, check blood lines for kink, and notify physician

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Catheter Removal

- Once the patient has had 6 successful treatments with the AVF, the registered nurse (RN) should obtain an order to have the catheter removed
- Successful = getting 2 needles in, no infiltrations, and reaching the prescribed BFR throughout the treatment for 6 treatments

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Clinical Clarification

- It is important to actively engage your critical thinking skills when deciding on the appropriate timing of catheter removal.

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New AVF Cannulation: Additional Points

- On removal of needles, for hemostasis:
 - Use 2-finger compression
 - Never use clamps
 - Hold sites for 10 minutes—no peeking

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Education for Patients

- Check fistula daily for a thrill and bruit
- Check for signs and symptoms of infection or other complications
- Write instructions for infiltrations

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Call the Nephrologist/Physician

- Thrill is undetectable
- Patient becomes feverish, dehydrated, or experiences low blood pressure