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Thrill Seekers

A Vascular Access Program Plus Cannulation Camp

Cannulation Camp Review

Cate Lewis, RN, CNN

Cannulation of the Arteriovenous Fistula (AVF)

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Mature Arteriovenous Fistula

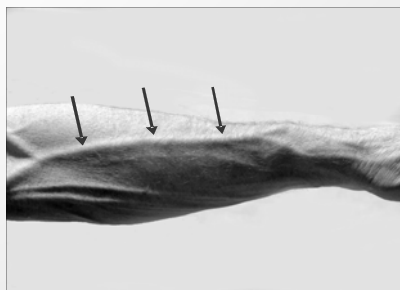


Photo courtesy of J. Rowland

Cannulating a Fistula

- The formal description of the process of inserting needles into a vascular access



Graphic courtesy of Medsystems HemoDYNAMIC Devices™

Assessment of the New AVF for Maturity



Fistula Maturation

- **Definition:** Process by which a fistula becomes suitable for cannulation (ie, develops adequate flow, wall thickness, and diameter)
- **Rule of 6's:** In general, a mature fistula should:
 - Be a minimum of 6 mm in diameter with discernible margins when a tourniquet is in place
 - Be less than 6 mm deep
 - Have a blood flow greater than 600 mL/min
 - Be evaluated for nonmaturation 4–6 weeks after surgical creation if it does not meet the above criteria

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

Fact

- Experienced dialysis nurses have an 80% success rate for identifying fistula maturity.

Robbin ML, et al. *Radiology.* 2002;225:59-64.

Maturing Fistula

- Vessel diameter must be 4–6 mm
- Vessel walls should toughen and be firm to the touch
- There should be no prominent collateral veins

Tourniquet



Photo courtesy of J. Holland

Clinical Clarification

- Several studies *suggest* that performing access exercises after surgery may contribute to the development of the fistula.¹⁻³ However, it is important to note that exercise alone will not turn a poor fistula into a good, functional fistula.

1. Rus RR, et al. *Hemodialysis Int.* 2005;9:275-280.
2. Leaf DA, et al. *Am J Med Sci.* 2003;325:115-119.
3. Oder TF, et al. *ASAIO J.* 2003;48:554-555.

During Maturation

- Feel for strong thrill at arterial anastomosis
- Listen for continuous low-pitched bruit
- Document fistula maturation, patient education

During Physical Examination

- Assess AVF for complications
 - Thrombosis
 - Stenosis
 - Infection
 - Steal syndrome
 - Aneurysms
- Select cannulation sites

Is This New AVF Mature and Ready for Cannulation?



AVF

Photo courtesy of D. Brouwer

Is This AVF Mature and Ready for the Initial Cannulation?

- a) Vein looks large enough
- b) Vein feels prominent and straight
- c) Vein has a strong thrill and good bruit
- d) Physician order
- e) All of the above

ANSWER:
(All of the above)

Fistula Maturation

- What diagnostic tools or techniques can be used to determine if an AVF is ready for cannulation?
- Can the same tools or techniques be used to select the cannulation sites?

Diagnostic Tools/Techniques to Determine If an AVF Is Ready

- Duplex Doppler study
- Physical exam by the:
 - Nephrologist
 - Nephrology nurse
 - Surgeon
- Angiogram (fistulogram)

Best Tool/Technique?

Physical Exam!

Look, Listen, and Feel

Use Your:

Eyes



Ears



Fingertips



Maturing Fistula Physical Exam

- Firm, no longer mushy
- Vessel wall thickening
- Vessel diameter enlargement (to 4–6 mm)
- Absence of prominent collateral veins

If in doubt, “Just Say No”

Look for Complications

Changes in Access

- Redness
- Drainage
- Abscess
- Cannulation sites
- Aneurysms

Infection

Changes in Access Extremity

- Skin color
- Edema
- Small blue or purple veins
- Hematoma
- Bruising

Central
or
outflow
vein
stenosis

- Distal Areas of Access
Extremity

• Hands/Feet:

Cold

Painful

Numb

• Fingers/Toes:

Discolored

Steal
syndrome

Stenosis

- Frequent cause of early fistula failure
- Juxta-anastomotic stenosis most common



Photo courtesy of L. Spergel, MD

Juxta-Anastomotic Stenoses

- Most common AVF stenosis
 - Vein segment immediately above the arterial anastomosis
 - Stenosis also may be present in artery
- Caused by
 - ? Trauma to segment of vein mobilized and manipulated by the surgeon in creating the AVF

Beathard GA. *A Multidisciplinary Approach for Hemodialysis Access*. New York, NY, 2002:111–118.
Beathard GA. *Semin Dial*. 1998;11:231–236.

Free Fistulagram

- Before the patient has needles inserted
 - Make a fist with access arm dependent; observe vein filling
 - Raise access arm; entire AVF should flatten/collapse if no stenosis/obstruction
- If a segment of the AVF has not collapsed, stenosis is located at junction between collapsed and noncollapsed segment
- Instruct patient to perform this at home

Auscultation

Listen for the Nature of the Bruit



Photo courtesy of J. Holland

Auscultation (cont'd)

Listen for Bruit

- Listen to entire access every treatment
- Note changes in sound characteristics (bruit):
 - A well-functioning fistula should have a continuous, machinery-like bruit on auscultation
 - An obstructed (stenotic) fistula may have a discontinuous and pulse-like bruit rather than a continuous one—and also may be louder and high-pitched or “whistling”
 - Louder at stenosis than at anastomosis

Protocol for *New* AVF Cannulation



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

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?

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)

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)

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

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)

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.

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

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

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

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

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)

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, $\frac{3}{5}$ ” AVF needles may advance fully into the shallow fistula
- Compare needle with fistula

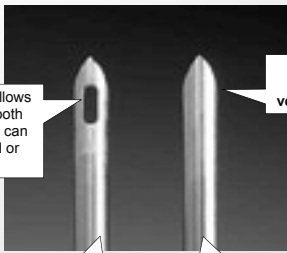
Matching Needle Gauge to the Prescribed BFR

- 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 \leq -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 \leq -250 mm Hg for all needle gauges and BFRs

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

Use Back-Eye Needles

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

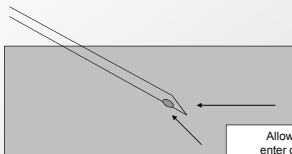


Arterial needle

Venous needle

Non-back-eye needle—for venous use only

Back-Eye Needle Flow



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

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

Catheters: Flushing and Heparinization

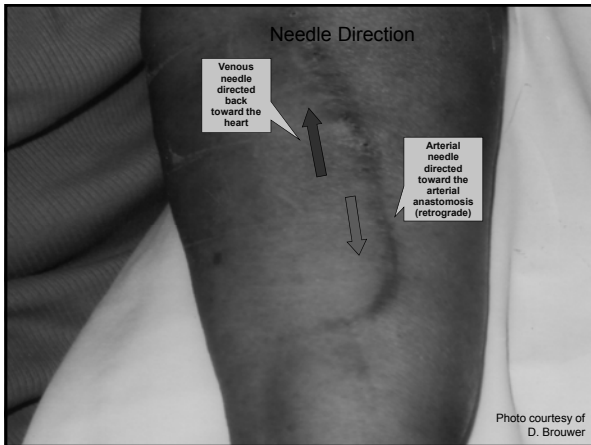
- If a catheter is in place:
- Consider any required adjustments to the heparin dose and timing for systemic heparinization (bolus, hourly, and end-time of hourly infusion) to prevent excess bleeding
 - Consider the procedure for flushing and heparin locking the catheter lumens pre- and post-hemodialysis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

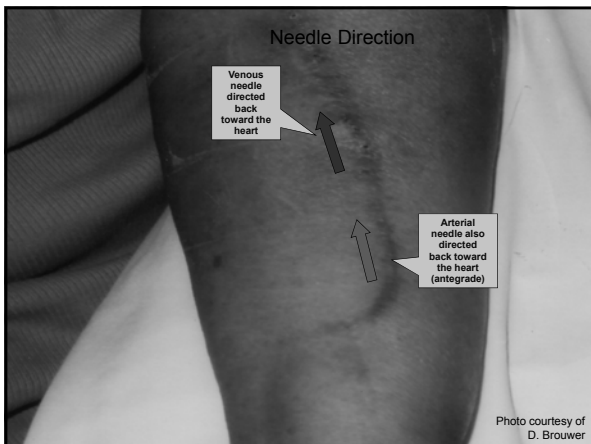
Patient Education

- 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)

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





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

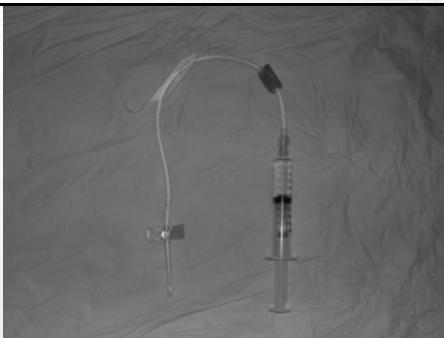
Consider Optional Use of “Wet” Needles

- 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

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

“Wet” Needle



When to Advance Needle Gauge

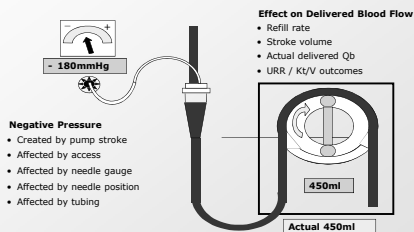
- When both fistula needles function for at least 3–6 hemodialysis treatments at prescribed blood flow rate (BFR) and needle gauge without:
 - Infiltration or hematoma
 - Cannulation difficulties
 - Access blood flow problems
 - Excessively negative pre-pump arterial pressures
 - Excessive venous pressures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

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

Pre-pump Arterial Monitoring

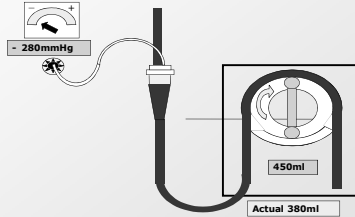
Normal Range*



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

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)

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

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

Call the Nephrologist/Physician

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

Cannulation Site Selection and Preparation



Identify Ideal Segment of AVF

- Look and feel for a straight segment of AVF
- Segment must be as long as the needle length (ie, 1" minimum)
- Stay at least 1.5" from the AVF anastomosis
- The arterial and venous needles need to be 1" to 1.5" apart
- Avoid curves, flat spots, and aneurysms to prevent complications

Skin Preparation

- Proper needle-site preparation by both the patient and staff reduces infection rates
- Once the skin site is properly cleansed, the skin should not be touched with bare hands or gloved hands
 - If touched, re-prepare the skin
- All site selection should be done prior to the final skin preparation

Cannulation Techniques



Cannulation Techniques

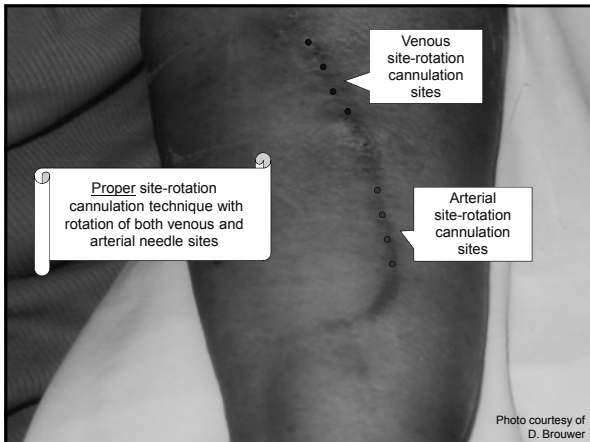
- | | |
|------------------|------------------|
| • Site-Rotation | • Buttonhole |
| – Also known as: | – Also known as: |
| ▪ Rope ladder | ▪ Constant-site |
| ▪ Rotating sites | ▪ Same-site |

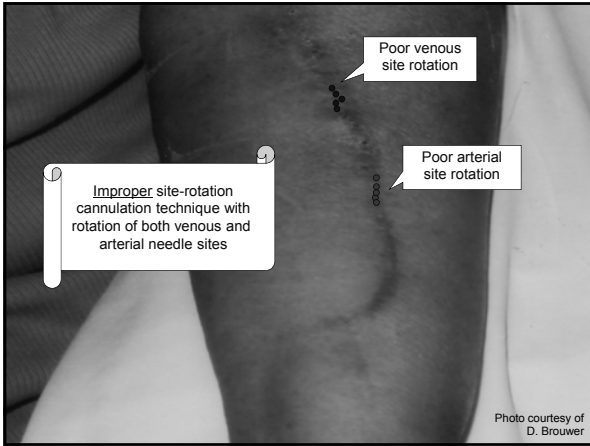
Site-Rotation Technique

- Cannulation sites are rotated up and down the AVF to use its entire length
- Classic technique used in most dialysis centers

Locating the Cannulation Site

- Look for straight areas of at least 1" for each cannulation site
- If you try to "straighten out" by *pulling* on the vessel to cannulate, the vessel will retract into its original position when released and lead to an infiltration
- Avoid aneurysms and flat or thinned-out areas
- Stay 1.5" away from the anastomosis
- Keep the needles at least 1.5" apart
- Each treatment requires 2 new sites





“One-site-itis”

- “One-site-itis” occurs when you stick the needle in the same general area, session after session
- Causes aneurysm and stenosis formation

AVF Aneurysm

- Caused by sticking needles in the same general area
- Aneurysm can also result from stenosis beyond the aneurysm, causing elevated back pressure

Photo courtesy of D. Brouwer

Needle Insertion

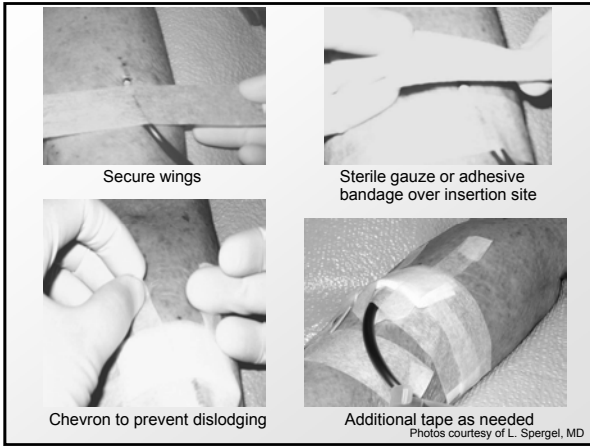
- Watch the orientation of the needle bevel, and avoid turning your wrist
 - If the bevel enters sideways, this can cause cutting of the vessel and/or a sidewall infiltration
- Use only a back-eye needle for the arterial needle
 - The venous needle can be back-eye or non-back-eye

Cannulation Technique

- Fistula needle/wings are the extension of your hands and fingers
- Slowly advance the needle
- Watch for blood flashback once the needle enters the vessel
- Level out the needle angle and slowly advance needle up the center of the vein
- Do not flip the needle
- Tape the wings to stabilize the needle
- Check for good flow
- Finally, chevron the tape to prevent needle from dislodging

Angles of Entry

- | | |
|---|---|
| Rule of Thumb: | Reality: |
| <ul style="list-style-type: none">• 20–35° angles for fistulae• 45° for grafts | <ul style="list-style-type: none">• Not every access fits the rule of thumb; some AV fistulae are very shallow and a lesser angle can be used• You will need to carefully assess the depth of the access and adjust the angle of cannulation accordingly |



Flipping Needles

- Historically, we flipped all needles because we did not have back-eye needles
 - Causes enlargement of the entrance hole, which allows blood to seep out around the needle during dialysis
 - Can cause coring of the access, requiring surgical closure of the hole
- If cannulation technique is correct, there is rarely a need to flip needle

Preparing for Cannulation

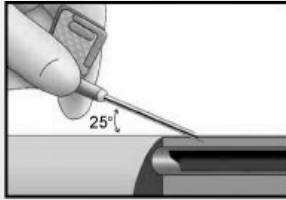
- Prep skin prior to cannulation
- Stabilize the skin and the AVF



Graphic courtesy of Medisystems HemoDYNAMIC Devices™

Insertion of Needle

- Use an approximately 20–35° angle of insertion depending on the depth of the access
- The angle is from the skin to the needle hub
- First, enter the skin and tissue above the AVF vessel, then the vessel



Graphic courtesy of Medisystems HemoDYNAMIC Devices™

Advancing the Needle

- Once the AVF vessel is entered, the blood flashback is visible in the needle tubing
- Level out and advance the needle with very minimal pressure



Graphic courtesy of Medisystems HemoDYNAMIC Devices™

Placement Is Crucial

- Do not “flip” or rotate the bevel of the needle 180°
 - Flipping can lead to stretching of the needle-insertion site and cause oozing during the dialysis treatment



Graphic courtesy of Medisystems HemoDYNAMIC Devices™

Needle Removal

- Apply gauze dressing without pressure
- Remove needle at insertion angle
- Apply pressure with 2 fingers
- Do not use excessive pressure
- Hold for 10–12 minutes, no peeking
- **Use stethoscope to check for bruit after applying dressing to stick site**

Summary

- Site-rotation or rope-ladder cannulation technique allows for improved needle site selection and use of the entire AVF for cannulation
- Proper site selection helps to ensure a successful cannulation
- Follow proper infection-control measures and your unit-specific cannulation policies and procedures

Summary (cont'd)

- AVF cannulation uses a lesser angle of insertion compared with graft cannulation
- Watch for blood flashback, then lower the angle and advance needle up the center of the vessel
- Use of back-eye needles eliminates the need to flip, or rotate, the needle bevel 180°

Summary (cont'd)

- Always use a tourniquet for AVF cannulation
- If using optional “wet-stick” method, check needle placement with a normal saline flush to ensure proper placement prior to initiation of the hemodialysis treatment
- Review and follow your unit-specific cannulation procedures for AVF and AVG cannulation procedures

For further information on cannulation and other AVF issues, please visit the official Fistula First Web site at:
www.FistulaFirst.org



Fistula first, catheter last

- Create a fistula culture in your unit
 - The patients pick up on our attitude
 - Your patients will benefit and so will you
-

Resources

- FistulaFirst.org

 - Network 4 website
ESRDNetwork4.org
-
