Mainenance, Surveillance, and Interventions for Native Fistulae

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Disclosures

- Consultant:
  - Bard, Medtronic, Cook

- Grant Support
  - Omnisonics
  - Cook
  - Boston Scientific
  - Bard
  - MirMedical
Objectives

- Discuss ongoing assessment needs
- Describe the different tools & processes used to monitor AVF
- Explain failure to mature

Clinical Scenario

- 50 year old African American female presents to emergency room with nausea, decreased appetite, & drowsiness which caused her to collapse at home.
- During the Hospitalization, she is diagnosed with acute worsening of what was likely chronic renal failure & her serum creatinine is now 6.5.
- During the hospital course she received a dialysis catheter to initiate hemodialysis. In-patient education has been limited & she now presents to your dialysis unit.
**GUIDELINE 1. PATIENT PREPARATION FOR PERMANENT HEMODIALYSIS ACCESS**

Appropriate planning allows for the initiation of dialysis therapy at the appropriate time with a permanent access in place at the start of dialysis therapy.

1.1 Patients with a glomerular filtration rate (GFR) less than 30 mL/min/1.73 m² (CKD stage 4) should be educated on all modalities of kidney replacement therapy (KRT) options, including transplantation, so that timely referral can be made for the appropriate modality and placement of a permanent dialysis access, if necessary. (A)

1.2 In patients with CKD stage 4 or 5, forearm and upper-arm veins suitable for placement of vascular access should not be used for venipuncture or for the placement of intravenous (IV) catheters, subclavian catheters, or peripherally inserted central catheter lines (PICCs). (B)

1.3 Patients should have a functional permanent access at the initiation of dialysis therapy. (B)

1.3.1 A fistula should be placed at least 6 months before the anticipated start of HD treatments. This timing allows for access evaluation and additional time for revision to ensure a working fistula is available at initiation of dialysis therapy. (B)

1.3.2 A graft should, in most cases, be placed at least 3 to 6 weeks before the anticipated start of HD therapy. Some newer graft materials may be cannulated immediately after placement. (B)

1.3.3 A peritoneal dialysis (PD) catheter ideally should be placed at least 2 weeks before the anticipated start of dialysis treatments. A backup HD access does not need to be placed in most patients. A PD catheter may be used as a bridge for a fistula in “appropriate” patients. (B)

1.4 Evaluations that should be performed before placement of a permanent HD access include (Table 1):

- History and physical examination, (B)
- Duplex ultrasound of the upper-extremity arteries and veins, (B)
- Central vein evaluation in the appropriate patient known to have a previous catheter or pacemaker. (A)

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**Ultrasound Access Planning**

- Ultrasound the entire arm with & without tourniquet
  - Radial artery > 2mm
  - Cephalic Vein ≥ 2.0 mm
  - Cephalic Vein should be continuous
  - Central stenosis evaluated by valsalva
  - Also look at cephalic above elbow, basilic & brachial for possible transfer

- Goal: to be able to tell the surgeon what vein to use for an AVF

Robbin et. al. Radiology 2000; 217: 83-88
Mendes et. al. JVS 2002; 36: 460-463
Venography

- Get complete imaging of veins from wrist to Heart
- Should be performed if suspect central stenosis or occlusion
- Performed in conjunction with treatments of failing accesses.
**CO₂ Venography**

- CO₂ 75% accurate for measuring stenoses in 32 patients with failing fistulae
  
  Ehrman et. al. JVIR 1994; 5:771-775

- CO₂ & Contrast equivalent for arterial measurements compared to IVUS
  
  McLennan et. al. JVIR 2001; 12:985-989

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**Nephrogenic Sclerosing Fibrosis**

- FDA Recommendation (2006): *When a patient with moderate to end-stage kidney disease needs an imaging study, select imaging methods other than MRI or MRA with a gadolinium-based contrast agent for the study whenever possible. If these patients must receive a gadolinium-based contrast agent, prompt dialysis following the MRI or MRA should be considered.*

- Gadolinium is not approved for angiography.

- 215 cases worldwide. 75 investigated—all had Gd & Gd was seen in skin biopsies.
Referral to Surgeon

- Many types of fistulae can be created.
- Simple AV Fistulae
  - Radial-Cephalic (forearm)
  - Brachial-Cephalic (arm)
  - Proximal Radial-Median antebrachial (forearm)
- Transpositions
  - Cephalic vein (forearm) to Radial artery
  - Basilic vein (forearm) to Radial artery
  - Cephalic vein (arm) to Brachial artery
  - Basilic vein (arm) to Brachial artery
  - Saphenous vein (thigh) to Femoral artery
  - Femoral vein (thigh) to Femoral artery
- Vein Translocations

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  - Femoral vein (thigh) to Femoral artery
- Vein Translocations
Where can fistulas be created?

Clinical Scenario

- Patient presents to your unit transferred from another city.
- He has dialyzed via a catheter for the last 14 months while the fistula in the right wrist has failed to mature.
- Physical exam shows a palpable cephalic vein with good thrill at the wrist for about 2 cm but there is no palpable vein above this point despite the presence of a thrill in the entire forearm.
K-DOQI

- 5.1.2 A program should be in place to detect early access dysfunction, particularly delays in maturation. The patient should be evaluated no later than 6 weeks after access placement. (B)

Is it hopeless?
Take home points

- Have an algorithm to assess all fistulas as they mature
- Don’t let catheters stay more than 2 months
- Assess accesses frequently as they mature & if they don’t mature by 2 months send them to be evaluated by fistulography.

Clinical Scenario

- 45 year old male is in your CKD clinic & has been followed for the last 3 months.
- GFR at initial visit was 42 & it has slowly decreased every month to 38, 34, & now it is 31.
- What do you do?
- Ultrasound Mapping
- Surgical Referral for fistula placement
- Reaffirm vein protection principles
  - No Iv's or blood draws above the hands
  - No picc lines in the arms
  - No Subclavian lines
  - Dialysis catheters are temporary bridges not permanent accesses.
  - Goal will be to have a functioning fistula

Clinical Scenario

- Patient in your unit has had a forearm loop graft for the last 3 years. It has had one prior declot about 8 months ago in which it was noted that the venous anastamosis was stenotic & needed angioplasty.
- Now you are having alarms on the machine indicating High venous pressures.
PTA 8mm

What to do?
Look for suitable veins in patients with grafts

- This patient has an arterialized upper arm cephalic vein
- Conversion to upper arm fistula can be performed
- Access could then be used immediately

Physical exam & Monitoring

- Important to examine the arms regularly with the sleeves up to look for additional veins that could be converted to fistulas.
- In patients with fistulas, the physical exam can identify changes in the fistula above & below the elbow
### Monitoring Techniques

- **4.1 Physical examination (monitoring):** Physical examination should be used to detect dysfunction in fistulae and grafts at least monthly by a qualified individual. (B)

  - **4.2 Surveillance of grafts:**
    - **4.2.1 Preferred:**
      - Intra-access flow by using 1 of several methods that are outlined in Table 7 using sequential measurements with trend analysis. (A)
    - **4.2.1.3 Duplex ultrasound.** (A)
    - **4.2.2 Acceptable:**
      - Physical findings of persistent swelling of the arm, presence of collateral veins, prolonged bleeding after needle withdrawal, or altered characteristics of pulse or thrill in a graft. (B)
    - **4.2.3 Unacceptable:**
      - Unstandardized dynamic venous pressures (DVPs) should not be used.

- **4.3 Surveillance in fistulae: Techniques, not mutually exclusive, that may be used in surveillance for stenosis in AVFs include:**

  - **4.3.1 Preferred:**
    - Direct flow measurements. (A)
    - Physical findings of persistent swelling of the arm, presence of collateral veins, prolonged bleeding after needle withdrawal, or altered characteristics of pulse or thrill in the outflow vein. (B)
    - Duplex ultrasound. (A)
  - **4.3.2 Acceptable:**
    - Recirculation using a non-urea-based dilutional method. (B)
    - Static pressures (B), direct or derived. (B)
Physical Examination

- Need to assess all patients monthly
- All patients with fistulae:
  - Assess current function
- All patients without fistulae:
  - Is there a vein that can be used to convert graft or catheter to fistula?
  - Communicate which vein to use to surgeon
- Examine all patients with tourniquet & look for cephalic vein
  - If cephalic is poor, is there an alternative?
  - Do I need imaging to find the vein?
- Supplement exam with flow screening if thrombosis rates high

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Physical Examination

- Thrill throughout = Normal access
- Pulsatile = Outflow stenosis
- No thrill and no pulse = Access thrombosis
- Examine weekly
- Follow trends
- Thrill at the venous end of dialysis grafts is predictive of successful outcome following intervention*

* Ponce P. et al JVIR 14 (2) pt 2, Feb 2003; S28-29
63 year old chronic dialysis patient has been dialyzing via left Brescia-Cimino fistula for the last 12 years without a problem.

On dialysis, the machine alarms & shuts down. Small clots are noted in the arterial line.

The needle is repositioned by an expert cannulator & the dialysis session still is terminated by “pulling clots”

What does “pulling clots” mean

- The most common cause of death on the dialysis machine is . . . **Disconnection**
- When a disconnection occurs, air gets into the line & to prevent a massive air embolus, the machine is shut down by an air bubble sensor.
- Small clots in the arterial line will look like a bubble to the sensor and shut the machine down.
- Clots will be visible in the line
What is happening?

- Is the needle in clot? Maybe—check the access
- Is the access clotted? Not if there is still a thrill
- Most commonly “pulling clots” is an indication of arterial inflow stenosis
- When flow is decreased in the artery, there is increased turbulence at the anastamosis

Clots form from decreased arterial flow

- Turbulence activates thrombomodulin locally & can cause small clots to form in the access that get in the tubing
PTA 7mm

Another Case of “Pulling Clots”
Clinical Scenario

- Pre-ESRD patient with 8 month old fistula
- While the fistula was previously palpable to above the elbow, now the fistula is only palpable just above the wrist and it is pulsatile. The patient is not on dialysis yet.

Fistula not functioning anymore

4/28/04

Gadolinium

6/9/04
Cephalic Vein!!

Cephalic Vein!!
44 y/o male who has dialyzed via left BCF for 2 years presents to dialysis unit with no thrill in the fistula.

- There is a small pulse at the anastomosis
- The normally plump outflow veins higher in the arm appear partially collapsed.
Thrombosed AVF

Procedure

- 3000 U Heparin
- PTD
- OTW Fogarty
- Treat stenoses

PTA 6mm

PTA 8mm
Post PTD

Later

Pt returns for high venous pressures

4 months Later
**Algorithms**

- Venography or ultrasound in all catheter & graft patients
- Look for conversions

- Algorithms to evaluate veins at Stage 3 & 4
  - Physical Exam
  - Ultrasound
  - Venography where needed

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**When to Refer for Imaging**

- 4.4 When to refer for evaluation (diagnosis) and treatment:
  - 4.4.1 One should not respond to a single isolated abnormal value. With all techniques, prospective trend analysis of the test parameter has greater power to detect dysfunction than isolated values alone. (A)
  - 4.4.2 Persistent abnormalities in any of the monitoring or surveillance parameters should prompt referral for access imaging. (A)

- 4.4.3 An access flow rate less than 600 mL/min in grafts and less than 400 to 500 mL/min in fistulae. (A)

- 4.4.4 A venous segment static pressure (mean pressures) ratio greater than 0.5 in grafts or fistulae. (A)

- 4.4.5 An arterial segment static pressure ratio greater than 0.75 in grafts. (A)
When to treat fistulae

• GUIDELINE 5. TREATMENT OF FISTULA COMPLICATIONS
  • Appropriate interventions for access dysfunction may result in an increased duration of survival of the AVF.
  
  • 5.1 Problems developing in the early period after AVF construction (first 6 months) should be promptly addressed.
    • 5.1.1 Persistent swelling of the hand or arm should be expeditiously evaluated and the underlying pathology should be corrected. (B)
    • 5.1.2 A program should be in place to detect early access dysfunction, particularly delays in maturation. The patient should be evaluated no later than 6 weeks after access placement. (B)
    • 5.2 Intervention on a fistula should be performed for the presence of:
      • 5.2.1 Inadequate flow to support the prescribed dialysis blood flow. (B)
      • 5.2.2 Hemodynamically significant venous stenosis. (B)
      • 5.2.3 Aneurysm formation in a primary fistula. Postaneurysmal stenosis that drives aneurysm also should be corrected. The aneurysmal segment should not be cannulated. (B)
      • 5.2.4 Ischemia in the access arm (B).

• 5.3 Indications for preemptive PTA:
  
  • A fistula with a greater than 50% stenosis in either the venous outflow or arterial inflow, in conjunction with clinical or physiological abnormalities, should be treated with PTA or surgical revision. (B)
    • 5.3.1 Abnormalities include reduction in flow, increase in static pressures, access recirculation preemtiting adequate delivery of dialysis, or abnormal physical findings. (B)

  • 5.4 Stenosis, as well as the clinical parameters used to detect it, should return to within acceptable limits following intervention. (B)
    • 5.5 Thrombectomy of a fistula should be attempted as early as possible after thrombosis is detected, but can be successful even after several days. (B)
    • 5.6 Access evaluation for ischemia: 5.6.1 Patients with an AVF should be assessed on a regular basis for possible ischemia. (B)

  • 5.7 Infection: Infections of primary AVFs are rare and should be treated as subacute bacterial endocarditis with 6 weeks of antibiotic therapy. Fistula surgical excision should be performed in cases of septic emboli. (B)
Summary

- Examine your patients at least monthly with sleeves up
- Use algorithmic monitoring scheme to find:
  - Non-maturing fistulae (within 2 months)
  - Fistulas with problems that need intervention
  - Grafts that can be converted to fistulae
- Algorithms & Formalized processes will improve the speed of referral & improved patient outcomes