Vascular Access Assessment, Monitoring, and Surveillance

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Today’s Challenges in Vascular Access

- Leading cause of hospitalization in the ESRD population
- Annual cost approaching $1.5 billion (USRDS, 2004)
- Current Medicare expenditures for ESRD are in excess of $21 billion annually (5-7% of total Medicare expenditures, for only 1% of Medicare beneficiaries)
- Aging population with diabetes as the leading cause of ESRD
- Our patients need an access that works better and lasts longer… *with less pain and suffering!*

K-DOQI Guidelines

- Kidney Disease Outcomes Quality Initiative launched in 1995
- Evidence-Based Clinical Practice Guidelines for patients and health care providers
- First Guidelines – 1997
- Currently 22 topics
- Three-stage review process
Guideline 2: Selection and Placement of Hemodialysis Access

- 2.1.1- Preferred: AV Fistulae (AVF)
- 2.1.2- Accepted – AV Graft (AVG)
- 2.1.3- Avoid if possible: Long-Term Catheters

Fistula First Breakthrough Initiative (FFBI) goal: 66% of hemodialysis patients utilizing AVF by June 30, 2009


- 4.1. Physical examination (monitoring)
- 4.2. Surveillance of grafts (preferred)
  - Intra-access flow
  - Static venous pressure
  - Duplex ultrasound
- Surveillance of grafts (acceptable)
  - Physical findings
- Unacceptable:
  - Unstandardized dynamic venous pressure (DPVs) should not be used

- Surveillance of fistulae (preferred)
  - Direct Flow Measurements
  - Physical findings
  - Duplex Ultrasound
- Surveillance of fistulae (acceptable)
  - Recirculation (using non-urea based dilutional method)
  - Static pressure, direct or derived

Continuum of Vascular Access Care

Look, Listen, Feel

Assessment

“Everyday” Every shift, Every patient

Monitoring and Surveillance

Vascular Access Program

Interventions

QA
Static pressure
DVP
Recirculation

Documentation

Angioplasty
Fistulagram
Thrombectomy
What Type of Access?

- How do I know if it is a fistula or graft?
  - Look for surgical scars at the wrist, upper arm and arm pit

Forearm Access

- Graft
  - Horseshoe shape
  - Two scars
  - Occlude to find artery

- Fistula
  - Usually straight
  - One scar at the wrist
  - Artery is distal
Upper Arm Access

- **Graft**
  - Two scars: one at the venous anastomosis and one at the arterial anastomosis
  - Usually straight or C-shaped
  - Rarely a loop
  - Arterial is distal

- **Fistula**
  - One scar at the anticubital-cephalic vein
  - Long scar that runs the length of the arm – basilic vein transposed
  - Other uncommon
  - Arterial is distal

CEPHALIC VEIN
TRANSPOSED BASILIC

Other Access Types

- Thigh graft
- Thigh fistula
- Chest loop graft
Physical Assessment

- Inspection (look)
- Auscultation (listen)
- Palpation (feel)

*Use all of your senses for assessment and then use your memory to compare and contrast the condition of the access to previous assessments*

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**Inspection**

- Inspection: **Look**
  - General development- AVF
  - Skin condition
  - ?? Aneurysms/ Pseudoaneurysms
  - Skin color of extremities (warm and dry)
  - Any swelling (is there symmetry)
  - Any sign of infection
  - Capillary refill < 2-3 seconds, look for ischemic spots on finger tips
**Inspection**

- Redness
- Drainage
- Abscess

- Skin Color
- Edema
- Small blue Purple veins

**Infection**
- Hands: cold, painful, numb
- Fingers: discolored

**Central or Outflow Vein stenosis**

**Steal Syndrome**

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**Auscultation**

- Auscultation: **Listen**
  - Quality and amplitude of bruit
  - Note pitch changes
  - Systolic and diastolic are louder on the arterial side
  - Pitch changes at areas of stenosis
  - Whistle or cough sound in the access
**Palpation**

- Palpation: **Feel**
  - Thrill or pulsation
  - Normally a thrill present at the anatomists site, and disappears after you manually occlude the AVF
  - If thrill remains = accessory veins
  - The thrill should lessen going to the venous limb of the access
  - Thrill can be felt at the site of stenosis
**Palpation (cont).**

- Vein Diameter
  - Feel the entire length of the AVF
  - Evaluate for needle site selection
  - Check for flat spots – you can see a stenosis and feel its thrill
  - Evaluate if new AVF is ready to cannulate

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**Fistula Exam**

- Raise the access arm above the heart
  - The fistula should completely collapse
  - Stenosis located at area of engorgement
  - Evaluate arterial inflow

- The Allen Test
Is the Access Working Properly?

- Clearances (URR) greater than 65
- Access flow greater than 600
- Venous pressure at 200 BRF less than 125
- Able to run prescription
- Other signs and symptoms of access pathology
  - Recirculation
  - Difficulty cannulating and pain in the access
  - Changes in thrill and bruit
  - Prolonged bleeding post-dialysis

Is New AVF Mature? Use the KDOQI “RULE of 6’s”

Vein MUST Mature PRIOR to the FIRST cannulation

- 6 cm of straight segment
- 6 mm Diameter
- Approximately 6 mm Depth below skin
- 600 mL/Min Access Blood Flow
- 8 week Post Op Check AVF Maturation

“Rule of 6’s”
**Central Stenosis and Occluded Veins**

- Arm swelling
- Prominent veins in the upper chest
- Prominent veins in the arm
- Swollen neck and face
- Look for signs of catheter on access side
- Look for pacemaker or defibrillator

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**What Causes the Stenosis?**

- Scarring at the cannulation sites from poor needle rotation
- Scaring the vein from the high arterial flows
- Scaring from implanted devices
- Aneurysm and pseudoaneurism formation
- Manipulation of veins
  - Transpositions, translocation
### Physical Findings of Venous Stenosis

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>NORMAL</th>
<th>STENOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrill</td>
<td>Only at the arterial anastamosis</td>
<td>At the site of stenotic lesion</td>
</tr>
<tr>
<td>Pulse</td>
<td>Soft, easily compressible</td>
<td>Water-hummer</td>
</tr>
<tr>
<td>Bruit</td>
<td>Low pitch, continuous, diastolic &amp; systolic</td>
<td>High-pitch, discontinuous, systolic only</td>
</tr>
</tbody>
</table>

### Clinical Indicators of Stenosis
- Clotting the system 2 or more times/month
- Difficult needle placement
- Persistently swollen arm
- Increased machine pressures
- Difficult achieving hemostasis at the end of treatment
- Decreased blood pump speeds
- Decreased Kt/V or URR (due to recirculation)
What is Steal Syndrome?

- Access “steals” blood from the hand
- Decreased blood supply to the hand
- Causes hypoxia (lack of oxygen) to the tissues of the hand resulting in severe pain
- Neurotic damage to the hand can occur
- Without oxygen tissue dies and necrosis occurs

Is Steal Syndrome Serious?

- Necrotic tissue can not be “fixed” – it must be removed (amputated)
- = Risk for infection
- = Risk for hospitalization
- = Risk for death!

- The Allen Test (within 3 seconds you should see capillary refill)
Vascular Access Complications

- Infiltrations/ Hematoma formation
  - Needle punctures the other side of the vessel
  - Blood leaks out into tissues
- Prevention
  - Correct cannulation technique
  - Get help when you need it!

Infiltrations

- During cannulation
  - Remove needle and wait for bleeding to stop.
  - Where do you insert new needle?
- During dialysis
  - Do not remove old needle
  - Recirculate blood while inserting new needle
  - Where do you insert new needle?
  - Apply ice to hematoma
What’s Wrong with this Picture?

- Aneurysms (fistulas)
- Pseudoaneurysms (grafts)
  - Repeated cannulation at same site
  - Unsealed needle puncture sites
  - Cause stenosis formation because of turbulence
- Prevention
  - Site rotation!!
  - Assure hemostasis at end of treatment

What’s Wrong with this Picture?

- Infections
  - Poor skin preparation
  - Break in aseptic technique
  - Poor patient hygiene
- Prevention
  - Proper site prep
Complications (cont).

- Bleeding during dialysis
  - Rotated needles
  - Manipulation of needles

- Recirculation
  - Stenosis
  - Needles too close together

Explanted Graft
What’s Wrong with this Picture?

Site Preparation & Cannulation
Site Preparation

- The patient should wash their access with antibacterial soap before coming to their chair.
- Staph is the leading cause of infection in dialysis patients (CDC).

Site Preparation (cont).

- Assess flow pattern
  - Gently depress the graft at the curve (or midpoint of a straight graft).
  - How do you know which is the arterial side?
Site Preparation (cont).

- Proper needle site preparation reduces infection rates
- Clean sites using concentric circles
- Clean with betadine or other germicidal agent
  - How long do you wait before inserting needles?
- What do you do if your patient is allergic to betadine?
- Once you have prepared

Prior to Cannulation

- Inject or apply local anesthesia, if applicable
- Prepare cannulation needle, remove cap
- With free hand stabilize the access without touching the cleaned sites
Cannulation

- Insert the needle (bevel up) at a 40 to 45 ° angle until a “flashback” of blood is visible (25 - 30 ° for AVF)
- Reduce angle and advance needle to hub

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Cannulation

- “Flip for a cause and not just because”
- There should be no resistance or pain
- Secure needle with tape and cover exit site with appropriate dressing
Cannulation Rules

- Always place the venous needle WITH the flow of blood
- Always keep the tips of the needles at least 2 inches apart to prevent recirculation
- Always keep the needles at least 1 ½ inches away from the anastomosis site
- Always rotate the puncture sites allowing 14 days for healing
- Apply a clean tourniquet when cannulating an AVF

Cannulation Rules (cont).

- Always determine the flow pattern of a loop graft prior to needle placement
- Always assess for patency
- Never “stick” a hematoma
- Never “stick” an infected area
- Never “stick” an aneurysm or pseudoaneurysm
Needle Removal

- Remove at same angle it went in
- “Flip” to original position if needle was “flipped” at initiation of treatment
- Do not apply pressure until needle is all the way out

Correct “flap” formation with good technique

Needle Removal

- Pressure
  - Cover both skin insertion site and graft insertion site
- Clamps
  - Use of clamps requires MD order
  - Must be removed and site checked for stasis (clotting) every 10 minutes
- Agents used for access stasis (in case of prolonged bleeding: > 30 min)
  - Gelfoam, for example
**Buttonhole Cannulation Technique**

- For native AV Fistulas only
- Sticking the same site using the same angle and depth every time
- Requires the same “sticker” until the track is formed (8 sticks, 12 for diabetics)
- Scab removal: disinfected tweezers or normal size saline-soaked 2x2’s
- Use a cannulation log for each needle
- Change to blunt needle once the track is formed so scar tissue is not cut, causing bleeding or hole enlargement

**Flow Methods in Dialysis Access**

- Duplex Doppler Ultrasound (DDU)
- Magnetic Resonance Angiography (MRA)
- Variable Flow Doppler Ultrasound
- Ultrasound Dilution (Transonics): UDT
- Crit-Line III or Crit-Line II
- Glucose Pump Infusion
- Urea Dilution
- Differential Conductivity (Gambro) (HDM)
- In-line Dialysate (FMC) - DD
Stenosis monitoring Environmental Scan
Results (ESRD Network 18)

- Facilities responded to scan - 189
- Facilities not performing stenosis monitoring – 29
- Duplex Doppler Ultrasound (DDU) – 22
- Magnetic Resonance Angiography (MRA) - 9
- Variable Flow Doppler Ultrasound - 7
- Ultrasound Dilution (Transonics): UDT - 41
- Crit-Line III -14
- Crit-Line II - 1
- In-line Dialysate (FMC) – 56
- Other: Dynamic Venous Pressure – 30
- Other - 9

Color-Flow Doppler

- Outpatient radiological procedure done quarterly
- Also called duplex ultrasound or duplex Doppler study
- Evaluates access flow patterns as well as areas of access stenosis
**Ultrasound Dilution Technique**
*(Transonics)*

- Conducted quarterly or as necessary
- AKA Crit-Line III or Crit-line TKA
- Very popular, but not all facilities have transonics on-site

**Dynamic Venous Pressure (DVP)**

- Conducted and recorded at the beginning of each treatment at a specified blood flow rate using specified/consistent needle size
- Non-standardized dynamic venous pressure are considered as unacceptable monitoring method by the K/DOQI workgroup
- Acceptable method for AVFs only! *(KDOQI 2006)*
**Static Venous Pressure (SVP)**

- Following a unit-specific procedure for measurement of venous and arterial measures at zero blood flow
- Conducted at least every 2 weeks
- Measurements plugged into mathematical formula
- Ratio > 0.5 is considered abnormal
- Refer for fistulagram after 3 abnormal readings

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**Other Methods**

- On-Line-Clearance (OLC) – conducted quarterly – Fresenious technology
- Magnetic Resonance Angiography
**Access Assessment Flow Sheet**

**Fistula or Graft**

- **Step 1:**
  - Yes: Good gentle pulse throughout?
  - No: Refer for evaluation

- **Step 2:**
  - Yes: Good Thrill and Bruit?
  - No: Refer for evaluation

- **Step 3:**
  - Yes: Attempt cannulation
  - No: Refer for evaluation

- **Step 4:**
  - Perform dialysis

**Access Assessment Flow Sheet**

**Catheter**

- **Step 1:**
  - Yes: Exit site clean without drainage or redness?
  - No: See catheter infection

- **Step 2:**
  - Yes: Cuff exposed or extruding?
  - No: Refer for evaluation

- **Step 3:**
  - Yes: Aspirating air from catheter?
  - No: Refer for evaluation

- **Step 4:**
  - Yes: Neck, facial or extremity swelling?
  - No: Refer for evaluation

- **Step 5:**
  - Perform dialysis
## Fistula or Graft

### Blood Flow Assessment
- **Ideal**
  - 400–500 ml/min
- **Borderline**
  - 350–400 ml/min
  - Refer for evaluation if URR < 70, abnormal or decreasing Transonic
- **Suboptimal**
  - < 350 ml/min
  - Refer for evaluation if needles and sites have been adjusted and continue to be a problem.
  - Abnormal venous pressures and falling Transonic values may be an indication of early fistula/graft failure
- **Poor**
  - < 250 ml/min
  - Activase per your center protocol, if no help refer for catheter change. If Activase is needed more than once per month, patient needs a catheter change

### Indications for Evaluation
- Prolonged bleeding post dialysis or oozing from puncture sites while needles are in
- Hematoma formation
- Hyperpulsality or water-hammer pulse
- High pitched bruit, especially systolic-only bruit
- Difficult or unusually painful cannulation
- Hypoperfusion of hand (cold, weak or painful hand)
- Painful dialysis
- Pulled clots
- Arm swelling
- New or worsening aneurysm (avoid sticking this area and run patient)
- Elevated venous pressure on more than one occurrence
- Abnormal or decreasing Transonic
- Immature access 4-6 weeks

## Catheter

### Blood Flow Assessment
- **Ideal**
  - > 350 ml/min
- **Borderline**
  - 300-350 ml/min
  - Refer for catheter change if URR < 70
- **Suboptimal**
  - 250-300 ml/min
  - Refer for catheter change if URR < 70
- **Poor**
  - < 250 ml/min
  - Activase per your center protocol, if no help refer for catheter change. If Activase is needed more than once per month, patient needs a catheter change

### Catheter Infections
- **Exit Site / Tunnel Infection**
  - Exit site red with drainage?
    - **Yes**
      - Culture site, blood culture x 2 and notify MD
    - Exit site with drainage AND catheter tunnel red and painful?
      - **Yes**
        - Culture site, blood culture x 2, notify MD and schedule catheter removal
- **Positive Blood Cultures**
  - Asymptomatic bacteremia with Coag Neg Staff and NO exit site/tunnel infection?
    - **Yes**
      - Refer for catheter exchange after antibiotics
  - Staph Aureus or Gram negative bacteremia?
    - **Yes**
      - Refer for catheter removal and replacement on separate days after antibiotics
**KDOQI Guideline 4: When to refer for evaluation (diagnosis) and treatment:**

- Do not respond to a single isolated episode
- Look for persistent abnormalities
- Access flow rate <600 mL/min for AVG and 400 to 500 mL/min in AVF
- A venous segment static pressure (mean pressures) ratio > 0.5 in AVG or AVF
- An arterial segment static pressure ratio > 0.75 in AVG

**Medicare Guidelines for Referral**

- **Venous outflow**
  - Elevated venous pressure
  - Prolonged bleeding
  - Decreased URR
  - Decreased Kt/V
  - Recirculation
  - Swelling of the extremity
  - Pulsatile graft
  - Loss of thrill
  - Aneurysms
  - Difficult or painful cannulation

- **Arterial inflow**
  - Low pressure in graft when outflow is occluded
  - Ischemic changes in extremity
  - Diminished intra-access flow (AKA: arterial pulling negative)
How often for Angioplasty?

- Some lesions are elastic
- Once scar starts to grow, it continues
- Scar grows at a different pace
- Acceptable interval is approximately 6 months
- May be more often, depending on the case

Why Angioplasty?

- Improves blood flow for better dialysis
- Decreased the rate of thrombosis of the access
- Prevents the need for surgery
- Extend the life of the access (from 2 to 7 years)
- There is a finite number of sites for an access
**All Patient should be taught how to:**

- Compress a bleeding access
- Wash skin over access with soap and water daily and before HD
- Recognize s/s of infection
- Select proper methods for exercising fistula arm with some resistance to venous flow
- Palpate for thrill/pulse daily
- Listen for bruit with ear opposite access if can’t palpate for any reason

**All patients should know to:**

- Avoid carrying heavy items and wearing occlusive closing over access
- Avoid sleeping on the access arm
- Be aware of site rotation (unless buttonhole cannulation method is used)
- Be aware of proper skin preparation and importance of staff wearing masks
- Report and s/s of infection and absence of bruit/thrill to staff immediately
In Closing

- The patient’s dialysis access is his or her lifeline; it is the job of the entire team to try to maintain it through routine monitoring and surveillance.
- Team education is key.
- Patients who are able to should be taught how to assess their own access.
- Listen to the patient.
- Follow up on the procedure report.