Fistula First- When is the Vein Too Small for an AVF?

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Disclosures

• Abbott – Endovascular medical advisory board
Background- AVF Creation

• National Kidney Foundation K/DOQI guidelines
  • Native arterial-venous fistula in 65% of patients with ESRD by 2009 and decreasing HD via catheters
  • CMS embraced this idea and the FFBI increased the target to 66% in 2009

• The wrist fistula is the first choice of access type because of the following advantages:
  • It is relatively simple to create.
  • It preserves more proximal vessels for future access placement.
  • It has few complications. Specifically, the incidence of vascular steal is low, and in mature fistulae, thrombosis and infection rates are low.
SVS Guidelines

• Endorses
  • Autogenous access construction
  • Access placed as distally as possible in the non-dominant arm

• “…in the push to perform all autogenous AV access, substandard veins are sometimes used for autogenous accesses, taking a long time to mature and thereby subjecting the patient to placement of catheters for hemodialysis.”

Creating a Functioning AVF

• **Perceived Benefits of early AVF placement:**
  • Decreased catheter related issues
  • Better patency vs graft

• **Reality can be sobering**
  • Much of KDOQI, NVAII and FFBI are not based on level I data
  • Maturation failure rates of 40-45%
  • Unclear if this strategy would demonstrate a benefit in a randomized trial.

Acceptable Size of the Vein

- Predicated on the Vascular Lab Assessment
  - There is no generally accepted “standard” for what constitutes vein mapping
- Commonly quoted criteria
  - Venous evaluation should include a luminal diameter of 2.5mm or greater, continuity with the proximal central veins, and absence of obstruction
  - Radial artery diameter greater than 2.0 mm
  - What is the data on size of the vein acceptable for AVF creation?
Size of the Vein and Creation of AVF - \textbf{1.6 mm}

- Wong et al.
  - 1996 reprinted in 2011
  - 60 patients underwent prospective US prior to AVF construction
  - Mean diameter at wrist 2.6mm; mid forearm-3.0mm and antecubital fossa-3.2mm
  - Utilized a Pulse generated runoff system- Cuff at hand fluctuated between 0-100mmHG and a second in the upper arm constant 40mm HG

Size of the Vein and Creation of AVF - **1.6 mm**

- Wong et al.
  - 38 AVF successful; 16 failed and 6 lost to follow up
  - Avg. diameter in successful group was 2.6 mm and failed group 2.7 mm
  - Majority of failures occurred in patients with vein less than 1.6 mm
  - Concluded that primary access should not be performed if the diameter of the artery and vein is less than 1.6 mm
Size of the Vein and Creation of AVF- 2.5 mm

• Silva et al.
  • 1998
  • 172 patients undergoing preoperative vein mapping
  • Autogenous access created if the vein was 2.5mm
  • Using US increases the number of autogenous access
  • Vein mapping protocol- utilized tourniquets and warm ultrasound gel- insonated with a 5MHz or 7 MHz probe; looked for continuity in veins
  • *Significant increase in autogenous access from 14% to 63%*

Size of the Vein and Creation of AVF - 3.0 mm

- Jayaraj et al.
- 160 patients undergoing US for HD access
- Two groups:
  - Group I - 3.0 mm without tourniquet
  - Group II - 3.0 mm with tourniquet
- Functional fistula at 6 months
- Failure rate Group I - 37.5% and Group II - 86%
- Concluded tourniquets resulted in higher number of patients qualifying for an AVF based on diameter but a much higher failure rate.

Size of the Vein and Creation of AVF - 4.0 mm

- Lauvao et al.
- Retrospectively reviewed 185 native AVF
- 158 patients
  - Performed US with and without a tourniquet
  - Studied numerous patient factors
- Found only factor associated of a functional fistula was the vein diameter > 4 mm

Size of the Vein and Creation of AVF- 2.0 mm

- Mendes et al.
- 44 consecutive patients undergoing RC AVF
- US obtained in every patient without use of tourniquet or cuff.
- Cephalic vein greater than 2.0mm proceeded to functional dialysis access in 76% while those less than 2.0 mm were functional 16% of time

Preoperative Evaluation

• All of these size criteria are predicated on one factor:
  • *Preoperative vein mapping*
  • No randomized studies identifying techniques
  • Room temperature-*no standardized criteria*
  • Patient position-*no standardized criteria*
  • Application of proximal pressure (tourniquet or cuff)-*not uniformly performed*
Duplex Vein Mapping- Known Variability

• Forearm vein mapping reported to vary up to 27% between different days when assessed under standardized conditions
• Superficial forearm veins have an important role in thermoregulation causing variability in measurements
• Corpataux found that wrist RC AVF can increase in size by 86% in one week

Forearm Venous Distensibility

• van der Linden et al
  • Compared distensibility with forearm veins utilizing strain gauge plethysmography (SGP) and US
  • 27 consecutive patients who were undergoing AVF
  • Controlled evaluation with SGP
    • Temperature 22C
    • Internal diameters
    • Cuff inflation protocol for SGP
    • No cuff utilized for US group

Forearm Venous Distensibility

• van der Linden et al

• Results
  • 17 patients underwent an AVF and 10 AVG
  • 8 functional and 9 nonfunctional AVF
  • Avg. cephalic vein diameter was 1.9mm in both functional and nonfunctional AVF
  • Venous distensibility was .66 ml/mmHG vs 46 ml/mmHG in those with successful vs unsuccessful AVF
  • Concluded that distensibility not diameter may be predictor of success
Venous Distension

• Malovrh et al.
• 116 patients approaching ESRD
  • Performed venous distension with proximal cuff inflated to 50 mm HG
  • Found the internal diameter of the vein (IDV) increased 0.230 +/- 0.071 cm to 0.333 +/- 0.117 cm after proximal venous congestion (45%, p<0.01)
• Positive correlation for IDV after PVC and successful AVF

Venous Distensibility

- Kim et al.
- 50 consecutive patients undergoing AVF
  - All underwent *venography*
  - Utilized an upper arm cuff
  - Found cephalic veins that were greater than 3.25 mm associated with a 4x success rate
  - Diameters that increased greater than 0.35 mm after tourniquet associated with a 7.4 x success rate

Kim JT, Chang WH, Oh TY, Jeong YK. Venous Distensibility as a Key Factor in the Success of Arteriovenous Fistulas at the Wrist. Ann Vasc Surg 2011; 25:1094-1098
Forearm cephalic vein cross-sectional area: Vein mapping protocol

- Planken et al.
- Evaluated Duplex using various venous congestion pressures
  - 10 healthy volunteers
  - Found that diameter measurement was observer independent
  - Best reproducibility with VCP of 40mmHG
Distensibility Protocol

• Korten et al.
  • All patients increased in size with all methods
  • No difference between healthy volunteers and renal patients.
  • Method 3 (sitting position and warmth) resulted in greatest increase in size
  • Suggest using this provocation method when assessing patients for RC AVF with small veins
  • *May increase attempts at RC AVF*
Review of Evidence of for Vascular US and HD access

• Ferring et al.
• Reviewed the literature on US and HD access
• Patients benefit from US in the following category:
  • Insufficient clinical examination (obese, prior surgery, etc)
  • Possible arterial disease
  • Prior venous/cannulation
  • *Should be used in selective patients*

Numerous Studies with Success

- Jennings et al.
  - Reviewed their large series of AVF creation
  - 75 RC AVF
  - Cephalic vein of 2.5 mm with tourniquet
  - Primary Patency/Primary assisted patency- 58.3%/96.2 %
  - Cumulative patency (including secondary) was 100% at 1 year
  - Surgeon performed US as part of PE and also in OR
  - Branch-patch technique for the anastomosis

Discussion

• Wide range of diameters that can be cited
• No stringent cut-off value
• Distension appears to be associated with successful AVF— further studies on this concept?
• Success my be surgeon dependent
• Bigger may not always be better
• What if future reimbursement is based the creation of a functional fistula?
Conclusion

- RC-AVF patency is poor
- Need to work with your vascular lab to identify techniques that will assist in success
- Clinical exam and judgment are still key
- 1.6mm to 2.0mm is likely too small and will fail!
Thank You!