Choosing Vascular Access in CKD/ESRD patients

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Vascular Access:
The Achilles' Heel of Dialysis

- Total allowed physician charges in 1999 for shunt creation procedures: $31 million
- Shunt complications: $19 million
- Inpatient covered charges for shunt creation and complications: $335 million

Plus: A Special Section on Water Treatment
Vascular Access: K/DOQI Guidelines

● AV fistula (AVF) is preferred.
  - Place AVF when-
    - serum creatinine > 4 mg/dL,
    - creatinine clearance < 25 mL/min, or
    - anticipation of RRT within a year

● AV graft (AVG)-
  - if unable to place AVF, or
  - failed attempt at AVF

● Catheters
  - should not be used as permanent access

Vascular Access Options

In ‘traditional’ order of preference-
- Primary AV Fistula
- Secondary AV Fistula
- Transposed AV Fistula
- AV Grafts
- Catheters
AV Fistula- Many Possible Sites

- Wrist (radio-cephalic) AVF
- Elbow (brachio-cephalic) AVF
- Brachio-basilic transposition AVF
- Synthetic arteriovenous graft – forearm, upper arm
- Secondary AVF
- Others – femoral, axilloaxillary, iliac femoral
AV Fistula

Pros
- High patency rate
- Low infection rate
- Low arterial steal rate with distal sites

Cons
- Frequent suboptimal veins
- High early failure rate (upto 40%)
AV Grafts

- Synthetic - placed if native AV fistula is not possible
- Synthetic materials include
  - PTFE
  - Vectra
  - cryopreserved artery/vein
  - bovine carotid artery
  - Vein allografts (long saphenous, human umbilical vein)
AV Grafts

Pros
- Short maturation time
- Easy to use/cannulate
- Multiple insertion sites and configurations
- Easy to declot/revise
- Better patency with better surveillance

Cons
- Synthetic- incites reaction
- Twice the rate of infection and 1.2 x the sepsis than AVF
- Lower patency than AVF- 4x thrombosis, and twice the rate of angioplasty
- Arterial steal in upper AVG
PTFE Grafts- Patency Rates

- Primary Patency rates for AV grafts of 70% at 1 year, 60% at 2 year, 50% at 3 year
- 3 year secondary patency rates 40-87% (mostly around 50%)
- Secondary patency rates for PTFE achieved at expense of 3-6 fold greater intervention rate
Permanent Catheters and Ports—Necessary Evils

Pros

● Easy outpatient insertion/removal
● Multiple sites
● Immediately available for HD
● No needlesticks

Cons

● Not adequate blood flow for long
● High infection rates
● May cause venous stenosis
● Cannot swim or take shower
Many Clinical Practice Guidelines!

- KDOQI 2006. CPG 2.1
- British Renal Association 1.1
- European Best Practice Guideline 3.2
- Canadian Society of Nephrology 1.3

Autogenous arteriovenous** fistulæ** should be **preferred over AVG** and AVG should be **preferred over catheters**
So, Which Access Should We Choose?

Need to answer the following questions:

– Is AVF always better than AVG?
– Is AVF ideal for everyone?
– When should one create an AV access?
– Do patient related factors (age, comorbidities) matter?
Is AVF always better than AVG?

<table>
<thead>
<tr>
<th>N</th>
<th>AVF</th>
<th>AVG</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary failure rate</td>
<td>46.4%</td>
<td>20.6%</td>
<td>0.001</td>
</tr>
<tr>
<td>Time to adequacy (days)</td>
<td>87 ± 40</td>
<td>18 ± 4</td>
<td>&lt; 0.001</td>
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<tr>
<td>Declot (year)</td>
<td>0</td>
<td>0.98</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PTA (year)</td>
<td>0.38</td>
<td>0.50</td>
<td>0.25</td>
</tr>
<tr>
<td>Surgical revision (year)</td>
<td>0.19</td>
<td>0.20</td>
<td>0.94</td>
</tr>
<tr>
<td>Total interventions (year)</td>
<td>0.57</td>
<td>1.67</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

N= 217 AV accesses

Allon 2001. KI 60: 2013-20
AVF and AVG - Cumulative Survival

Cumulative access survival (time from access creation to access failure), including primary access failures ($P = 0.97$)

Cumulative access survival (time from access creation to access failure), excluding primary access failures ($P = 0.03$)

Cumulative Survival of AVF and AVG at a Single Dialysis Facility

2004-2008

2009-2013

1 Derived from data residing in chair-side computing system, by rule-based algorithm

2 Provided by Dr. Chaim Charytan, Dr. Stephen Ash, and Vasc-Alert, LLC
COMPETING RISKS - ESRD Vs. DEATH

Risk of death > risk of ESRD

Risk of ESRD > risk of death

O'Hare et al. JASN 2007: 18; 2758-2765
Life Expectancy Trade-Off With Vascular Access

- Patients with life expectancy <3–6 months
  - No benefit of AVF placement due the maturation time
- A life expectancy of >1 year is needed to derive benefit

Moist L et. al Seminars in Dialysis 2011
Lee t et al – CJASN 2007
AVF Vs. AVG in the Elderly Patient: Advantages?

- **Infection** – 200 AVF to prevent one episode of AVG related infection (Kurella et al, KI 2012)

- **Survival** - No benefit for patients >80 yrs, but high CVC use vs AVG (43% vs 25%) (DeSilva et al JASN 2013)

Worse patency of AVF than younger patients and less likelihood of accessing AVF for HD in elderly (Richardson et al, J Vasc Access 2009, O’Hare et al KI 2007)
The Heart Failure Patient

- Both AVF and AVG can increase CV risks:
  - Increased cardiac output
  - Pulmonary hypertension
  - LVH and diastolic dysfunction
- In mild CHF, AVF may be tolerated, but avoid high flow AVF
- NYHA class III and IV - Consider PD
- A ‘planned’ tunneled catheter may be a reasonable choice
The Diabetic Patient

- Diabetics have overall poor circulation
  - Calcified arteries
  - Poor veins
  - Repeated venipunctures
- Higher incidence of steal in upper arm AVF
- Evaluate vessels prior to access creation
- Prefer mid forearm AVF
And The Obese Patient

- Obesity (often associated with diabetes)- poor vasculature
- Deeper veins, pressure of soft tissue- especially in axilla
- But, veins likely spared from venipuncture
- May be able to get AVF with transposition and liposuction or fat removal surgically
- Primary and secondary failure are higher than in non-obese

Kats et al. KI 2007;71:39
Access in Patient with Other Co-morbidities

- Good history and physical examination are essential for planning vascular access placement
- Consider situations like
  - Previous CVA
  - Mastectomy
  - Cardiac implantable electrical devices
- Choice of extremity and location may have to be changed
Access in Patient with Failing AV access, Transplant or PD

- Failing transplant/PD- Evaluate early for an AV access
- AV access with frequent thromboses, angioplasties or pseudoaneurysms- Consider secondary AV fistula
- Existing tunneled catheter- check venogram for presence of central vein stenosis before creation of new access
For Those with Failing Access: Secondary AV Fistula

Fig. 1. (a) Forearm arteriovenous graft (AVG) in use prior to conversion to Type I secondary arteriovenous fistula (SAVF). (b) Forearm AVG conversion to Type I SAVF (postoperative).

Intractable Central Vein Stenosis: Hybrid Graft-Catheter

HeRO™ Graft

Gore Hybrid Graft™
Individualizing Access: Points to Ponder

- Mature AVF is better than AVG
- Immature AVF requires more salvage procedures, prolonged catheter use- sepsis, central vein stenosis- **NOT** Better than AVG
- Life expectancy of the patient (elderly, terminal illness with palliative dialysis), competing risks-ESRD and death
- Comorbidities- CHF (fistula toxicity), PVD, obesity

Allon M and Lok CE Clin J Am Soc Nephrol. 2010
Unintended Consequences of ‘One Size Fits All Approach’

- Less ‘individualized’ patient management
- Limited ability of the physician to prescribe appropriate access
- Possible adverse outcomes (a’ la increased transfusion rates in anemic patients with restricted ESA use)
- Possibility of individual harm
- Increased cherry picking- difficult access for sick patients unable to get AVF
- Decrease innovation and product development
## Approaches:
Clinical use of the scoring system

<table>
<thead>
<tr>
<th>Variable</th>
<th>Points</th>
<th>Score</th>
<th>Variable definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥ 65 yrs</td>
<td>+2</td>
<td>+2</td>
<td>age at time of AVF creation</td>
</tr>
<tr>
<td>PVD</td>
<td>+3</td>
<td>+3</td>
<td>documented lower extremity revascularization, digit or extremity amputation, history of claudication and ischemic extremity changes or gangrene</td>
</tr>
<tr>
<td>CAD</td>
<td>+2.5</td>
<td>+2.5</td>
<td>documented coronary stenosis by angiography or history of MI or previous coronary revascularization by angioplasty, stenting or bypass surgery</td>
</tr>
<tr>
<td>White</td>
<td>-3</td>
<td>-3</td>
<td>not of black, Asian, aboriginal or other non-European descent</td>
</tr>
<tr>
<td>baseline score</td>
<td>+3</td>
<td>+3</td>
<td>all patients are given baseline score of +3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>+3</td>
<td>sum of all scores</td>
</tr>
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Lok CE 2006. JASN 17: 3204-12
Risk of Fistula Non-Maturation

Lok 2006. JASN 17: 3204-12
Proposed Algorithm

Individualizing Vascular Access: AVF or AVG?

**Mr. Doe**
- 76-years old
- Diabetic
- CAD with EF 20%
- CVA x 2
- Lives in a NH
- Barely manages ADL

**AVG**

**Mrs. Smith**
- 76-years old
- HTN
- Active, volunteers 20hrs/week
- Independent

**AVF**
We Know We Must Individualize