# In what patients should we not place an AVF?

A Q Urbanes, MD
Lifeline Vascular Access
19 November 2010
ASN Denver, CO

# K/DOQI 2006 CPG

- 2.1 The order of preference for placmeent of fistulae in patients with kidney failure who choose HD as their initial mode of RRT should be (in descending order of preference):
  - 2.1.1 Preferred: Fistulae
  - 2.1.2 Acceptable: AVG of synthetic or biological material
  - 2.1.3 Avoid if possible: Long-term catheters

# Mission of FFBI

- maximize AVF placement in all suitable patients
- minimize dialysis catheter use
- avoid all types of vascular access complications

www.fistulafirst.org

# Clinical Practice Guidelines

- British Renal Association
  - 1.1. We recommend that any individual who commences HD should do so with an AVF as 1st choice, an AVG as 2nd choice, and tunneled venous catheter as 3rd choice and a non-tunneled catheter as an option of necessity.
- Canadian Society of Nephrology
  - 1.3 The preferred type of vascular access is a radio-cephalic native vessel AVF.

## Clinical Practice Guidelines

- European Best Practice Guidelines 2007
  - 3.1 The access should provide sufficient blood flow to perform adequate hemodialysis.
  - 3.2 Autogenous arteriovenous fistulae should be preferred over AVG and AVG should be preferred over catheters.

## Why the desire for more AVFs?

- lasts longer
  - less maintenance-intensive
  - less infection
    - provides better dialysis

# successful AVF

- different definitions
  - successful 2-needle cannulation with Qb ≥ 300 ml/min for 3 hrs, for 1 month
  - successful 2-needle cannulation for 1 dialysis session

| series | primary AVF failure rate |
|---|---|
| Allon (2001) | 46.4% |
| Feldman (2003) | 44.5% |
| Ravani (2005) | 23.0% |
| Lok (2006) | 44.5% |
| Huijbregts (2008) | 40.0% |

# functional AVF patency

- n = 491 AVFs (649 total permanent access)
  - 170 (40%) 1° failure rate

| Patency | n | 6 mos (%) | 95% CI |
|---|---|---|---|
| From surgical placement | | | |
| 1° | 212 | 57 | 52 - 62 |
| assisted 1° | 262 | 69 | 65 - 73 |
| 2° | 284 | 75 | 71 - 79 |
| From 1st cannulation | | | |
| 1° functional | 137 | 70 | 64 - 76 |
| assisted 1° functional | 171 | 85 | 80 - 90 |
| 2° functional | 184 | 90 | 86 - 94 |

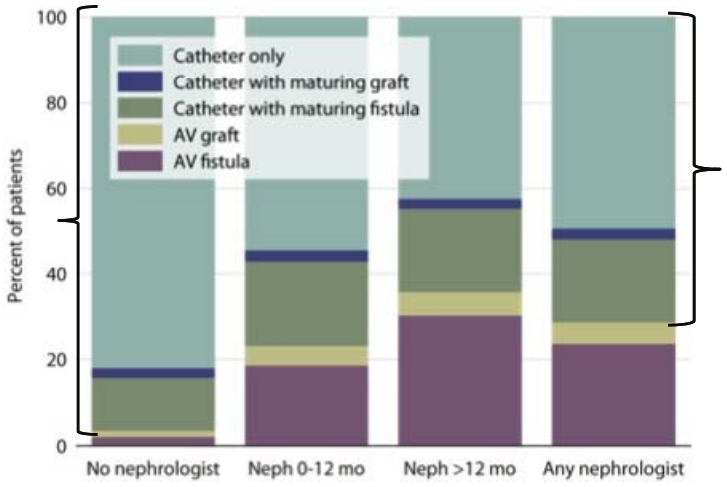
Huijbregts 2008. CJASN 3: 714-9.

# Outcomes of AVF vs. AVG

| | AVF | AVG | *P*-value |
|---|---|---|---|
| Primary failure rate | 46.4% | 20.6% | 0.001 |
| Time to adequacy (days) | 87 ± 40 | 18 ± 4 | < 0.001 |
| Declot (year) | 0 | 0.98 | < 0.001 |
| PTA (year) | 0.38 | 0.50 | 0.25 |
| Surgical revision (year) | 0.19 | 0.20 | 0.94 |
| Total interventions (year) | 0.57 | 1.67 | < 0.001 |

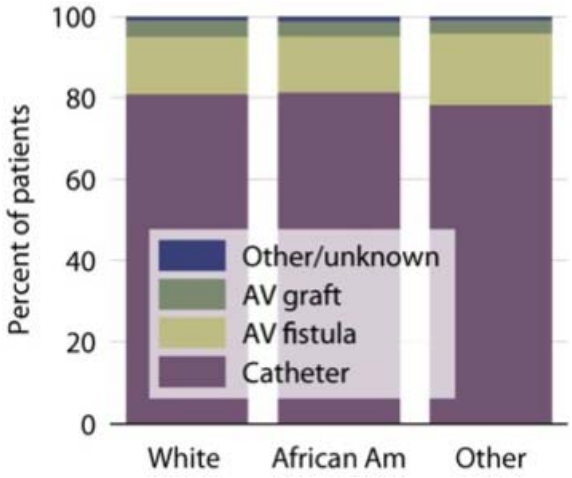
Allon 2001. KI 60: 2013-20.

# Access use at 1st out-patient dialysis, 2008



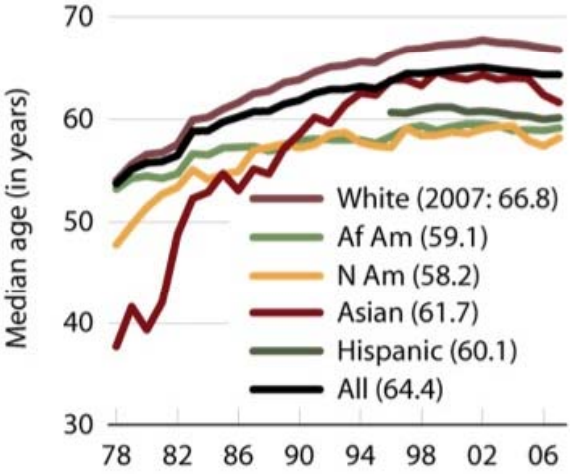

USRDS 2010

# 1st access at initiation; pts with ≥12 months of nephrologist care



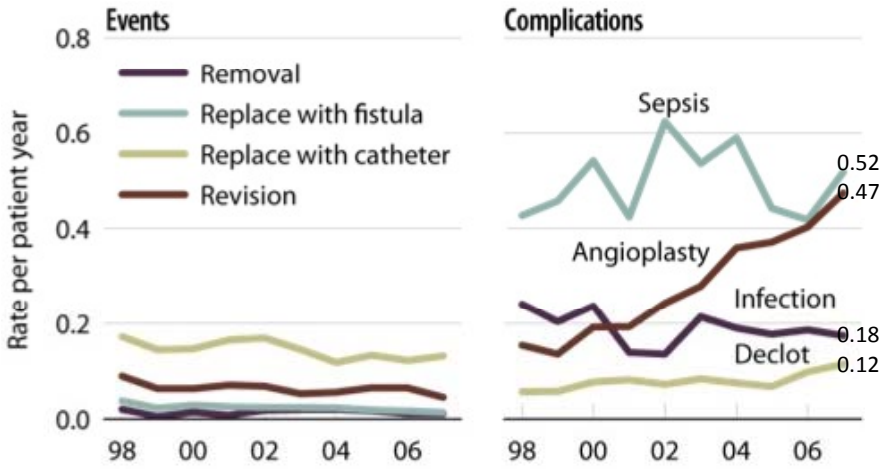

USRDS 2010

# Median age of incident patients by race/ethnicity



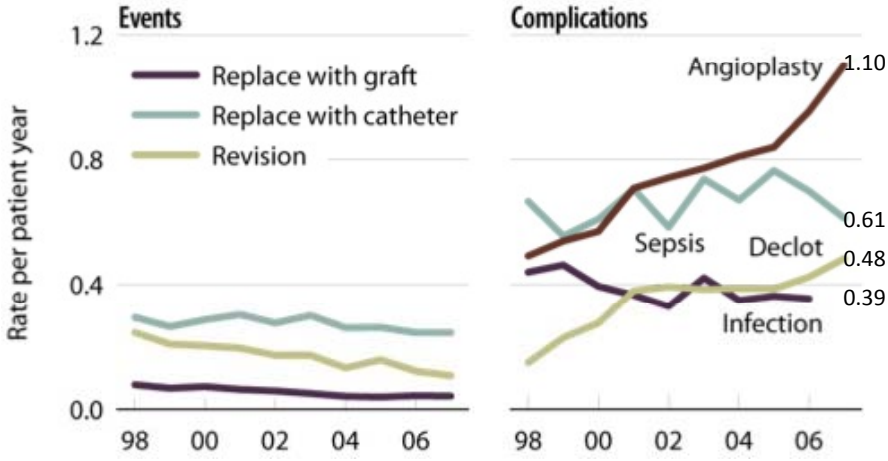

USRDS 2009

# AVF events & complications




USRDS 2010

# AVG events & complications

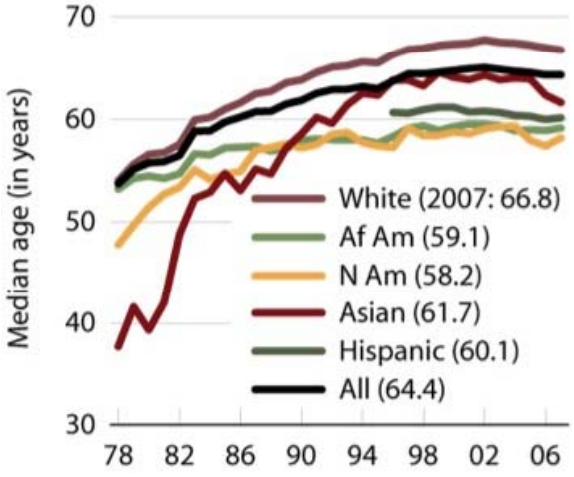



USRDS 2010

# Case

- Diabetic patient eGFR 20 ml/min, has elected for in-center hemodialysis, is evaluated for vascular access creation in anticipation of initiating RRT. Would your recommendations be different if patient were
  - female vs male
  - < 65 yrs vs ≥ 65 yrs old
  - BMI < 30 vs BMI > 30

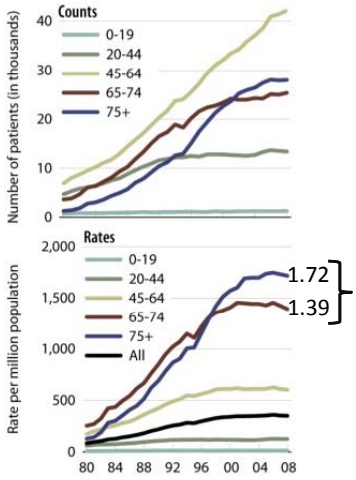
# Median age of incident patients by race/ethnicity



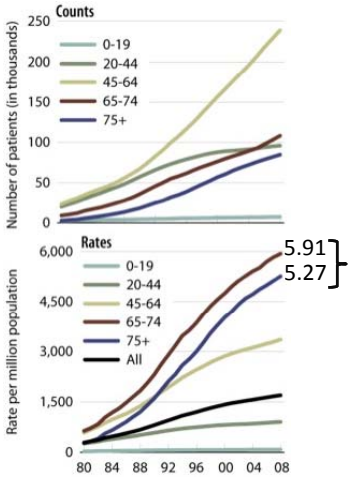

USRDS 2009

# Incidence & prevalence counts/rates by age

Incidence




Prevalence




USRDS 2010

# Outcomes of AVF vs. AVG

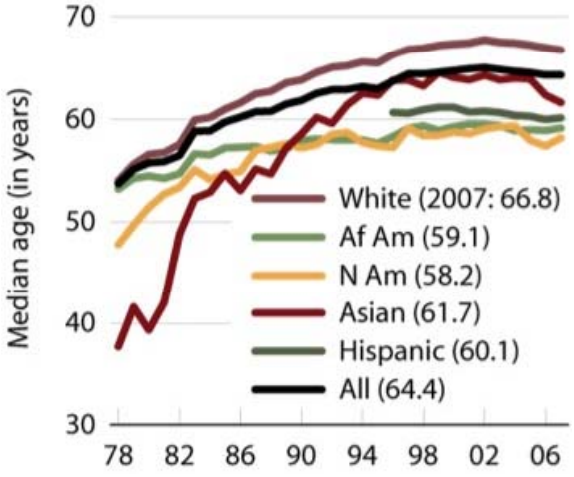
| | AVF | AVG | *P*-value |
|---|---|---|---|
| Primary failure rate | 46.4% | 20.6% | 0.001 |
| Time to adequacy (days) | 87 ± 40 | 18 ± 4 | < 0.001 |
| Declot (year) | 0 | 0.98 | < 0.001 |
| PTA (year) | 0.38 | 0.50 | 0.25 |
| Surgical revision (year) | 0.19 | 0.20 | 0.94 |
| Total interventions (year) | 0.57 | 1.67 | < 0.001 |

Allon 2001. KI 60: 2013-20.

# Case

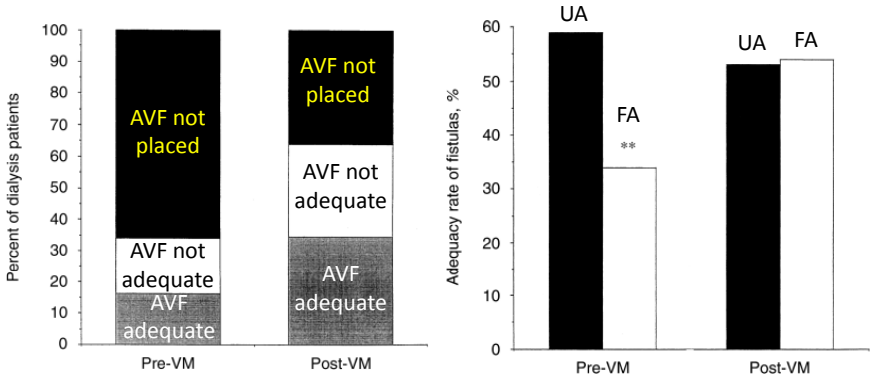
- Diabetic patient eGFR 20 ml/min, has elected for in-center hemodialysis, is evaluated for vascular access creation in anticipation of initiating RRT. Would your recommendations be different if patient were
  - female vs male
  - < 65 yrs vs ≥ 65 yrs old
  - BMI < 30 vs BMI > 30

# Median age of incident patients by race/ethnicity



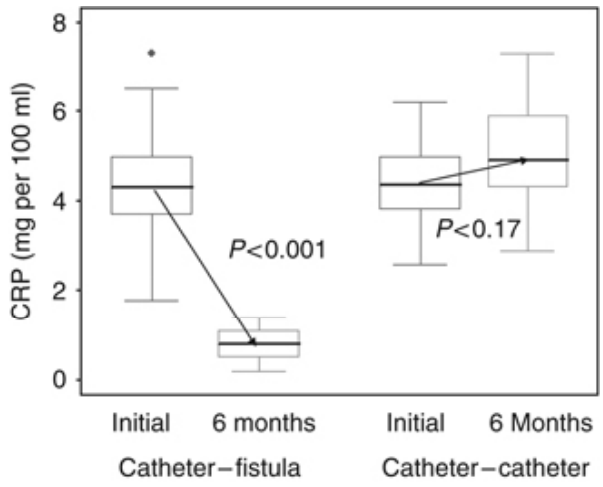

USRDS 2009

# Effect of pre-operative mapping



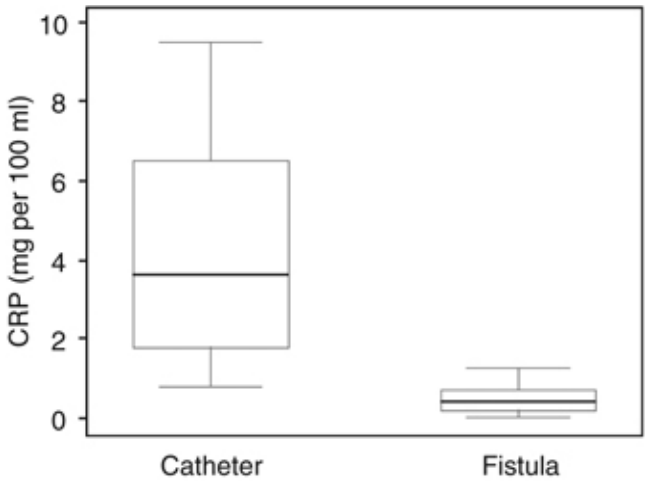

Allon 2001. KI 60: 2013-20.

# CVC and inflammation




Goldstein. KI 2009; 76: 1063-9.

# CVC and inflammation




Goldstein. KI 2009; 76: 1063-9.

# Vascular access and the elderly

## Elderly vs. elderly

- WHO defines “elderly” in the context of geo-social environment
  - ≥ 65 yrs in Westernized industrial countries
  - 50 yrs in Third World countries
- Is there a difference between “young elderly” and “old elderly?”

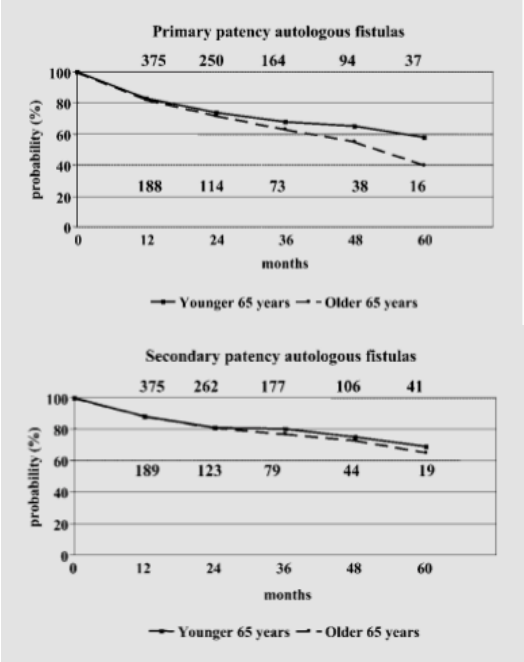
## Access survival in elderly without vascular mapping

- retrospective analysis of 1st AVFs or AVGs placed between Jan 1992 to Mar 1997
- AVG vs AVF decided based on physical examination
  - selective central venography
- early failure: access lost for use within 30d after creation
- complications: include all alterations of access needed for continuous use of access

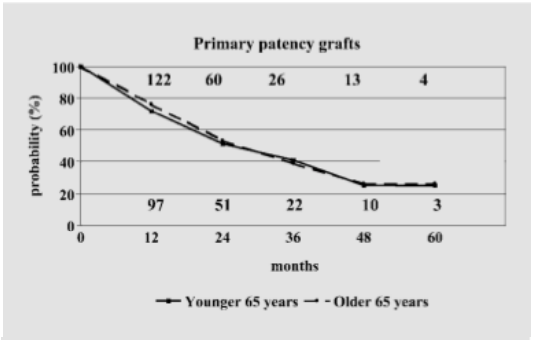
Riado-Cano 2002. Blood Purif 20: 563-68.

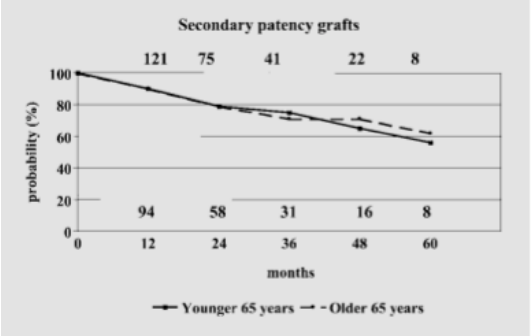
| | < 65 years (n = 548) | ≥ 65 years (n = 324) | *P*-value |
|---|---|---|---|
| early failure | | | |
| autologous AVF (%) | 4.6 | 2.3 | n.s. |
| AVG (%) | 0.7 | 2.7 | n.s. |
| complication rate | | | |
| autologous AVF (%) | 0.07 | 0.12 | < 0.01 |
| AVG (%) | 0.5 | 0.8 | < 0.001 |

Riado-Cano 2002. Blood Purif 20: 563-68.




Riado-Cano 2002. Blood Purif 20: 563-68.




Riado-Cano 2002. Blood Purif 20: 563-68.

# Pre-operative arterial and venous diameters (≥65yrs vs <65 yrs)

| Parameter | ≥ 65 yrs | < 65 yrs | *P*-value |
|---|---|---|---|
| forearm AVF (mm) | | | |
| artery diam | 2.7 ± 0.5 | 2.6 ± 0.5 | 0.770 |
| vein diam | 3.0 ± 0.5 | 3.0 ± 0.4 | 0.690 |
| upper arm AVF (mm) | | | |
| artery diam | 4.8 ± 1.1 | 5.2 ± 1.2 | 0.280 |
| vein diam | 4.3 ± 1.1 | 4.8 ± 1.5 | 0.100 |

Peterson 2008. CJASN 3: 437-41.

# Likelihood of adequate new AVF with pre-operative mapping

| | *n* AVF | *n* adequate | % adequate | OR | 95% CI | *P* value |
|---|---|---|---|---|---|---|
| all patients | 84 | 45 | 54% | | | |
| site of AVF | | | | | | |
| upper arm | 45 | 24 | 53% | 0.98 | 0.42 – 2.32 | 0.96 |
| forearm | 39 | 21 | 54% | | | |
| DM | | | | | | |
| (+) | 45 | 22 | 49% | 0.66 | 0.28 – 1.58 | 0.35 |
| (-) | 39 | 23 | 59% | | | |
| Race | | | | | | |
| black | 59 | 32 | 54% | 1.09 | 0.43 – 2.78 | 0.85 |
| white | 25 | 13 | 52% | | | |

Allon 2001. KI 60: 2013-20.

# Likelihood of adequate new AVF with pre-operative mapping

| | *n* AVF | *n* adequate | % adequate | OR | 95% CI | *P* value |
|---|---|---|---|---|---|---|
| Age | | | | | | |
| ≥ 65 yrs | 12 | 5 | 42% | 0.57 | 0.17 – 1.97 | 0.37 |
| < 65 yrs | 72 | 40 | 56% | | | |
| Gender | | | | | | |
| female | 36 | 16 | 44% | 0.52 | 0.22 – 1.26 | 0.15 |
| male | 48 | 29 | 60% | | | |
| BMI | | | | | | |
| ≥ 27 kg/m2 | 31 | 16 | 52% | 0.79 | 0.32 – 1.97 | 0.61 |
| < 27 kg/m2 | 47 | 27 | 57% | | | |

Allon 2001. KI 60: 2013-20.

## Overall success rate in achieving useable AVF when pre-operative vascular mapping is used

| | % of pts with AVF placed | % of AVF that were useable | % of all pts with useable AVF |
|---|---|---|---|
| All patients | 64% | 54% | 34% |
| Gender | | | |
| female | 50% | 44% | 22% |
| male | 74% | 60% | 44% |
| Age | | | |
| ≥ 65 yrs | 62% | 42% | 26% |
| < 65 yrs | 64% | 56% | 36% |
| BMI | | | |
| ≥ 27 kg/m2 | 68% | 52% | 35% |
| < 27 kg/m2 | 60% | 57% | 34% |

Allon 2001. KI 60: 2013-20.

## Vein diameter as predictor of AVF maturation (n = 298)

- functional maturation
  - successful cannulation of AVF; Qb 350-400 ml/min for 4 hrs or less
- primary failure
  - AVF abandonment prior to cannulation

| Risk factor | *P*-value | OR | 95% CI |
|---|---|---|---|
| age 65-99 yrs | 0.672 | 0.79 | 0.26 – 2.37 |
| gender | 0.254 | 0.52 | 0.17 – 1.60 |
| DM | 0.482 | 1.56 | 0.45 – 5.50 |
| HTN | 0.749 | 1.36 | 0.21 – 8.76 |
| largest vein size on DUS | 0.002 | 0.15 | 0.04 – 0.50 |
| BCAVF | 0.170 | 0.45 | 0.14 – 1.41 |

Lauvao 2009. J Vasc Surg 49: 1499-504.

# 1º RC AVF success

(n = 113)

| Independent variable | OR | *P*-value | 95% CI |
|---|---|---|---|
| gender (male vs female) | 3.57 | 0.010 | 1.36 – 9.38 |
| indirect vessel measurement vs. no measurements | 1.18 | 0.689 | 0.52 – 2.71 |
| age <65 vs ≥ 65 | 1.69 | 0.240 | 0.70 – 4.05 |
| DM | 1.92 | 0.140 | 0.80 -4.61 |
| IHD | 1.31 | 0.580 | 0.50 – 3.40 |
| CHF | 1.21 | 0.680 | 0.49 – 3.00 |
| PVD | 0.41 | 1.40 | 0.12 – 1.36 |
| CVD | 186 | 0.340 | 0.52 – 6.74 |

Wang 2008. CJASN 3: 78-84.

# 1º BC AVF success

(n = 92)

| Independent variable | OR | *P*-value | 95% CI |
|---|---|---|---|
| gender (male vs female) | 0.79 | 0.659 | 0.29 – 2.19 |
| indirect vessel measurement vs. no measurements | 0.25 | 0.016 | 0.08 – 0.78 |
| age <65 vs ≥ 65 | 1.91 | 0.200 | 0.71 – 5.14 |
| DM | 0.66 | 0.410 | 0.24 – 1.78 |
| IHD | 0.59 | 0.310 | 0.21 – 1.65 |
| CHF | 1.46 | 0.490 | 0.51 – 4.10 |
| PVD | 0.66 | 0.470 | 0.21 – 2.03 |
| CVD | 2.34 | 0.210 | 0.61 – 8.98 |

Wang 2008. CJASN 3: 78-84.

# AVF in the elderly after previous failed access

- retrospective analysis of 348 HD patients > 65 yrs old (ave 71 yrs), with previous failed access, referred from 72 different centers
- GN 23.7%, APCKD 16.1%; PN 13.5%; DM 9.3%
- mean time on dialysis 3.1 ± 2.1 years

| | early failure rate (%) |
|---|---|
| elbow AVF | 1.8% |
| forearm AVF | > 20% |
| AVG | 16.5% |

Berardinelli 1998. NDT 13S7: 73-7.

# AVF outcomes in the elderly

- retrospective study of 444 1st AVF creations
  - 196 (44%) ≥65 yrs old (mean age 74 ± 5.9)
    - 68.9% Caucasian
    - 32.6% HTN etiol
  - 248 (56%) <65 yrs old (mean age 42 ± 12)
    - 63.3% Caucasian
    - 33.9% GN etio
- primary end-point: cumulative (2°) patency

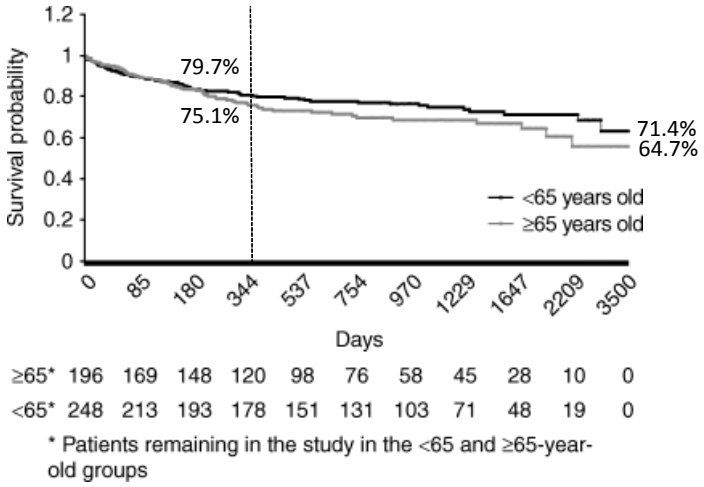
Lok 2005. KI 67: 2462-69.

# Reasons for AVF loss

| | < 65 yrs | ≥ 65 yrs | *P* value |
|---|---|---|---|
| thrombosis/stenosis | 34 (0.56) | 24 (0.44) | 0.71 |
| failure to mature | 21 (0.34) | 28 (0.49) | 0.05 |
| RC | 11 | 16 | 0.02 |
| BC | 8 | 9 | 0.80 |
| BB | 1 | 3 | 0.80 |
| aneurysm/rupture | 3 (0.05) | 1 (0.02) | 0.44 |
| ligation for steal | 1 (0.02) | 3 (0.05) | 0.21 |
| ligation for high CO | 2 (0.03) | 0 (0.00) | 0.21 |
| total losses | 61 | 57 | |
| total losses as % of total AVF | 25% | 29% | |
| FTM as % of total AVF | 8.5% | 14.3% | |

Lok 2005. KI 67: 2462-69.

# 2° (cumulative) AVF survival
# < 65 yrs vs. ≥ 65 yrs old




Lok 2005. KI 67: 2462-69.

# Cumulative patency

| | 6 months | | 12 months | | 24 months | | 36 months | | mean (days) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | <65y | ≥65y | <65y | ≥65y | <65y | ≥65y | <65y | ≥65y | <65y | ≥6ry |
| Over-all | 83.3 | 82.9 | 79.7 | 75.1 | 77.7 | 71.6 | 74.8 | 68.7 | 1950 | 1550 |
| RC | 85.9 | 80.4 | 83.5 | 72.5 | 82.6 | 66.7 | 80.9 | 62.9 | 2089 | 1477 |
| BC | 81.1 | 86.6 | 77.5 | 79.4 | 73.2 | 77.2 | 64.8 | 72.9 | 801 | 1504 |
| BB | 76.9 | 67.5 | 68.4 | 54.0 | NA | NA | NA | NA | 162 | 415 |

RC vs BB *P* value 0.004
BC vs BB *P* value 0.008

Lok 2005. KI 67: 2462-69.

# Procedure rates (events/access year)

| Age group | Angioplasty | | Thrombolysis | | Surgical revision | |
|---|---|---|---|---|---|---|
| | < 65 | ≥ 65 | < 65 | ≥ 65 | < 65 | ≥ 65 |
| Overall | 0.29 | 0.31 | 0.10 | 0.02 | 0.06 | 0.28 |
| RC | 0.30 | 0.30 | 0.09 | 0.02 | 0.03 | 0.61 |
| BC | 0.26 | 0.32 | 0.09 | 0.03 | 0.04 | 0.002* |
| BB | 0.33 | 0.35 | 0.26 | 0.26 | 0.40 | 0.00 |

**P* value 0.02

Lok 2005. KI 67: 2462-69.

# 1° patency of AVF

| | 6 months | | 12 months | | median (days) | |
|---|---|---|---|---|---|---|
| | <65 | ≥65 | <65 | ≥65 | <65 | ≥65 |
| Overall | 80.5 | 86.1 | 65.1 | 64.8 | 747 | 645 |
| RC | 77.5 | 84.8 | 62.8 | 58.6 | 777 | 544 |
| BC | 87.1 | 88.7 | 69.9 | 70.8 | 683 | 1004 |
| BB | 61.5 | 66.7 | 49.2 | 33.3 | 402 | 301 |

Lok 2005. KI 67: 2462-69.

Comparing elderly vs. non-elderly groups, there was no difference noted in:

- primary patency or time to 1st intervention
- # of interventions needed to maintain patency
- adequacy of dialysis delivered
- over-all cumulative (secondary) patency

Failure of fistula maturation was almost twice more commonly seen in the ≥65y vs. <65y group.

Lok 2005. KI 67: 2462-69.

# REDUCE FTM I

- Risk Equation Determining Unsuccessful Cannulation Events and Failure to Mature in Arteriovenous Fistulas
- derivation patients from University Health HD (Toronto, Canada) – 422 patients
- validation patients additionally from 3 other Canadian University Centers and 1 North American University Center

Lok 2006. JASN 17: 3204-12.

# Clinical risk factors evaluated

- age
- gender
- race
- case of ESRD
- vintage on dialysis
- access placement
- surgeon
- anatomic configuration
- side
- co-morbidities
  - DM
  - HTN
  - CAD
  - PVD
  - cerebrovascular disease
  - CHF
  - dyslipidemia
  - active smoker
  - overweight

Lok 2006. JASN 17: 3204-12.

# Clinical use of the scoring system

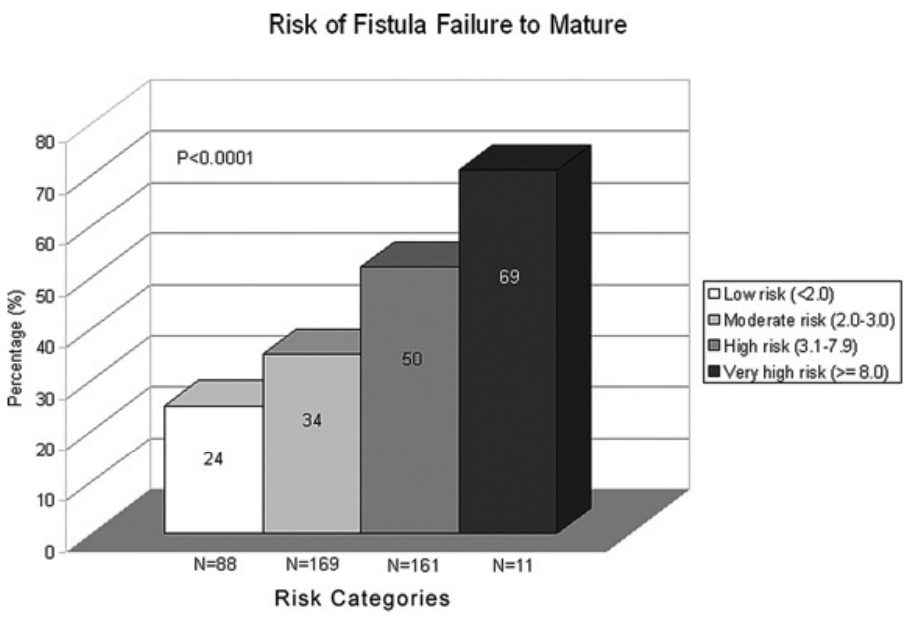
| Variable | Points | Score | Variable definitions |
|---|---|---|---|
| Age ≥ 65 yrs | +2 | | age at time of AVF creation |
| PVD | +3 | | documented lower extremity revascularization, digit or extremity amputation, history of claudication and ischemic extremity changes or gangrene |
| CAD | +2.5 | | documented coronary stenosis by angiography or history of MI or previous coronary revascularization by angioplasty, stenting or bypass surgery |
| White | -3 | | not of black, Asian, aboriginal or other non-European descent |
| baseline score | | +3 | all patients are given baseline score of +3 |
| Total | | | sum of all scores |

Lok 2006. JASN 17: 3204-12.

# Example of use of FTM predicted risk categories

| Score | Risk Category[b] | Clinical Application[c] |
|---|---|---|
| <2.0 | Low risk: 25% | PE[d] ± duplex ultrasound; create AVF |
| 2.0 to 3.0 | Moderate risk: 35% | PE,[d] duplex ultrasound ± venogram; create AVF |
| 3.1 to 6.9 | High risk: 50% | Arteriogram + venogram and appropriate preoperative intervention as necessary; create AVF with very close postoperative monitoring (*e.g.*, weekly or biweekly), and anticipate the need for aggressive intervention to facilitate maturation |
| ≥7.0 | Very high risk: 70% | Consider another form of permanent access (*e.g.*, graft); continue to avoid catheter use |

Lok 2006. JASN 17: 3204-12.




Lok 2006. JASN 17: 3204-12.

# RC vs BC AVF in elderly

- retrospective analysis of 658 pts who underwent 1st access procedure
  - only 86% proceeded to hemodialysis
  - 361 RC AVFs; 297 BC AVFs
- "successful" AVF: used for HD
- only selected patients underwent pre-operative DUS mapping
- factors analyzed
  - age, DM, HTN, gender, ethnicity, prior dialysis

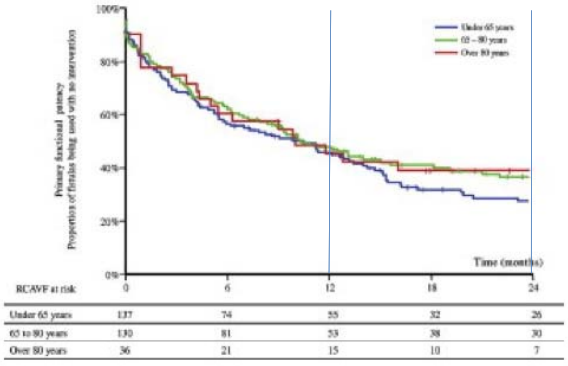
Weale 2008. J Vasc Surg 47: 144-50.

- RC AVF
  - 54% successfully used
  - female gender
    - OR 2.24
    - 95% CI 1.387-3.638
    - *P*-value 0.001
- BC AVF
  - 54.2% successfully used
  - DM
    - OR 2.095
    - 95% CI 1.261-3.482
    - *P*-value 0.004

| Fistula type | ≤ 65 yrs (%) | 65-79 yrs (%) | ≥ 80 yrs (%) | P ($\chi^2$) |
|---|---|---|---|---|
| RC AVF | 68/137 (49.6%) | 75/131 (57.3%) | 21/36 (58.3%) | 0.391 |
| BC AVF | 55/110 (50.0%) | 64/107 (59.8%) | 22/53 (51.2%) | 0.317 |

Weale 2008. J Vasc Surg 47: 144-50.

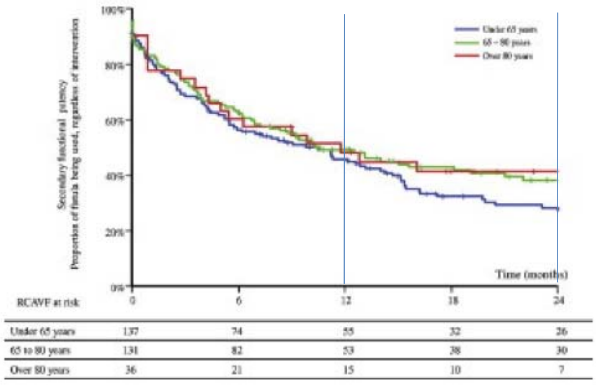
# 1º patency of RC AVF




| | < 65 yrs | 65-79 yrs | ≥ 80 yrs |
|---|---|---|---|
| 1 yr | 46.0% | 47.0% | 45.7% |
| 2 yrs | 27.1% | 36.0% | 38.1% |

Weale 2008. J Vasc Surg 47: 144-50.

# 2º patency of RC AVF




| | < 65 yrs | 65-79 yrs | ≥ 80 yrs |
|---|---|---|---|
| 1 yr | 46.1% | 47.8% | 47.8% |
| 2 yrs | 27.8% | 37.5% | 39.9% |

Weale 2008. J Vasc Surg 47: 144-50.

# OR of factors associated with AVF failure to mature

| Covariates | *P*-value | aOR | 95% CI |
|---|---|---|---|
| BMI (kg/m2) | | | |
| < 30 | reference | | |
| ≥ 30 | 0.33 | 1.52 | 0.66 – 3.48 |
| Age (per year) | 0.81 | 1.00 | 0.98 – 1.03 |
| Gender (female) | 0.80 | 0.90 | 0.40 – 2.02 |
| Black ethnicity (vs. non-black) | 0.16 | 1.73 | 0.81 – 3.72 |
| Co-morbidities | | | |
| PVD | 0.81 | 1.13 | 0.44 – 2.89 |
| DM | 0.28 | 1.49 | 0.73 – 3.07 |

Chan 2008. Semin Dialy 21: 274-9.

# OR of factors associated with AVF requirement for revision

| Covariates | *P*-value | aOR | 95% CI |
|---|---|---|---|
| BMI (kg/m2) | | | |
| < 30 | reference | | |
| ≥ 30 | 0.18 | 0.35 | 0.08 – 1.59 |
| Age (per year) | 0.08 | 1.03 | 1.00 – 1.06 |
| Gender (female) | 0.18 | 1.84 | 0.76 – 4.45 |
| Black ethnicity (vs. non-black) | 0.79 | 0.87 | 0.30 – 2.48 |
| Co-morbidities | | | |
| PVD | 0.94 | 1.04 | 0.34 – 3.16 |
| DM | 0.57 | 0.77 | 0.32 – 1.87 |

Chan 2008. Semin Dialy 21: 274-9.

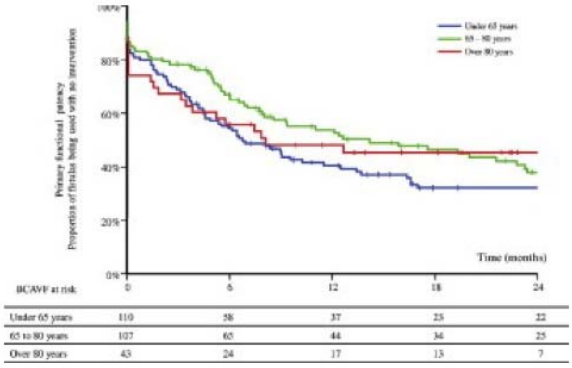
# factors affecting RC AVF patency

| Factor | HR | 95% CI | *P*-value |
|---|---|---|---|
| 1° patency | | | |
| female gender | 1.657 | 1.246 - 2.205 | 0.001 |
| prior HD | 1.331 | 1.007 - 1.759 | 0.031 |
| 2° patency | | | |
| female gender | 1.625 | 1.220 - 2.164 | 0.001 |
| prior HD | 1.359 | 1.026 - 1.801 | 0.033 |

Age group did <u>not</u> influence loss of primary or secondary function.

Weale 2008. J Vasc Surg 47: 144-50.

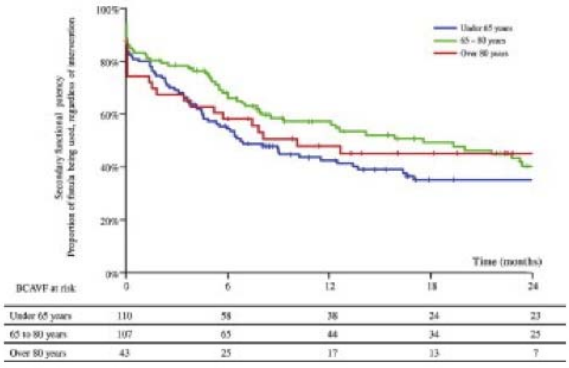
# 1º patency of BC AVF




| | < 65 yrs | 65-79 yrs | ≥ 80 yrs |
|---|---|---|---|
| 1 yr | 39.3% | 53.3% | 46.3% |
| 2 yrs | 31.0% | 37.5% | 42.6% |

Weale 2008. J Vasc Surg 47: 144-50.

# 2º patency of BC AVF




| | < 65 yrs | 65-79 yrs | ≥ 80 yrs |
|---|---|---|---|
| 1 yr | 41.0% | 55.7% | 46.3% |
| 2 yrs | 33.6% | 39.2% | 42.6% |

Weale 2008. J Vasc Surg 47: 144-50.

# AVF and gender

# Pre-operative arterial and venous diameters (female vs. male)

| Parameter | female | male | *P*-value |
|---|---|---|---|
| forearm AVF (mm) | | | |
| artery diam | 2.4 ± 0.4 | 2.8 ± 0.5 | 0.001 |
| vein diam | 3.1 ± 0.4 | 3.0 ± 0.4 | 0.240 |
| upper arm AVF (mm) | | | |
| artery diam | 4.8 ± 1.2 | 5.4 ± 1.0 | 0.008 |
| vein diam | 4.6 ± 1.6 | 4.6 ± 1.2 | 0.940 |

Peterson 2008. CJASN 3: 437-41.

# Pre-operative arterial diameters (FTM female vs successful female)

| Parameter | FTM | successful | *P*-value |
|---|---|---|---|
| forearm AVF (mm) | | | |
| artery diam | 2.4 ± 0.4 | 2.3 ± 0.4 | 0.55 |
| upper arm AVF (mm) | | | |
| artery diam | 5.0 ± 1.0 | 5.1 ± 1.4 | 0.086 |

Peterson 2008. CJASN 3: 437-41.

# Likelihood of adequate new AVF with pre-operative mapping

| | *n* AVF | *n* adequate | % adequate | OR | 95% CI | *P* value |
|---|---|---|---|---|---|---|
| Age | | | | | | |
| ≥ 65 yrs | 12 | 5 | 42% | 0.57 | 0.17 – 1.97 | 0.37 |
| < 65 yrs | 72 | 40 | 56% | | | |
| Gender | | | | | | |
| female | 36 | 16 | 44% | 0.52 | 0.22 – 1.26 | 0.15 |
| male | 48 | 29 | 60% | | | |
| BMI | | | | | | |
| ≥ 27 kg/m2 | 31 | 16 | 52% | 0.79 | 0.32 – 1.97 | 0.61 |
| < 27 kg/m2 | 47 | 27 | 57% | | | |

Allon 2001. KI 60: 2013-20.

## Overall success rate in achieving useable AVF when pre-operative vascular mapping is used

| | % of pts with AVF placed | % of AVF that were useable | % of all pts with useable AVF |
|---|---|---|---|
| All patients | 0.64 | 0.54 | 0.34 |
| Gender | | | |
| female | 0.50 | 0.44 | 0.22 |
| male | 0.74 | 0.60 | 0.44 |
| Age | | | |
| ≥ 65 yrs | 0.62 | 0.42 | 0.26 |
| < 65 yrs | 0.64 | 0.56 | 0.36 |
| BMI | | | |
| ≥ 27 kg/m2 | 0.68 | 0.52 | 0.35 |
| < 27 kg/m2 | 0.60 | 0.57 | 0.34 |

Allon 2001. KI 60: 2013-20.

## 1º RC AVF success

(n = 113)

| Independent variable | OR | *P*-value | 95% CI |
|---|---|---|---|
| gender (male vs female) | 3.57 | 0.010 | 1.36 – 9.38 |
| indirect vessel measurement vs. no measurements | 1.18 | 0.689 | 0.52 – 2.71 |
| age <65 vs ≥ 65 | 1.69 | 0.240 | 0.70 – 4.05 |
| DM | 1.92 | 0.140 | 0.80 -4.61 |
| IHD | 1.31 | 0.580 | 0.50 – 3.40 |
| CHF | 1.21 | 0.680 | 0.49 – 3.00 |
| PVD | 0.41 | 1.40 | 0.12 – 1.36 |
| CVD | 186 | 0.340 | 0.52 – 6.74 |

Wang 2008. CJASN 3: 78-84.

# 1º BC AVF success

(n = 92)

| Independent variable | OR | *P*-value | 95% CI |
|---|---|---|---|
| gender (male vs female) | 0.79 | 0.659 | 0.29 – 2.19 |
| indirect vessel measurement vs. no measurements | 0.25 | 0.016 | 0.08 – 0.78 |
| age <65 vs ≥ 65 | 1.91 | 0.200 | 0.71 – 5.14 |
| DM | 0.66 | 0.410 | 0.24 – 1.78 |
| IHD | 0.59 | 0.310 | 0.21 – 1.65 |
| CHF | 1.46 | 0.490 | 0.51 – 4.10 |
| PVD | 0.66 | 0.470 | 0.21 – 2.03 |
| CVD | 2.34 | 0.210 | 0.61 – 8.98 |

Wang 2008. CJASN 3: 78-84.

# 1º and 2º AVF survival

| | < 65 yrs | | | ≥ 65 yrs | | |
|---|---|---|---|---|---|---|
| | n | 1 yr | 2 yrs | n | 1 yr | 2 yrs |
| 1º access survival | | | | | | |
| female non-DM | 125 | 67% | 51% | 98 | 73% | 63% |
| female DM | 28 | 69% | 62% | 55 | 78% | 70% |
| male non-DM | 225 | 85% | 75% | 119 | 77% | 68% |
| male DM | 59 | 70% | 61% | 39 | 81% | 72% |
| 2º access survival | | | | | | |
| female non-DM | 125 | 95% | 89% | 98 | 95% | 92% |
| female DM | 28 | 84% | 84% | 55 | 88% | 80% |
| male non-DM | 225 | 98% | 96% | 119 | 95% | 94% |
| male DM | 59 | 84% | 75% | 39 | 89% | 84% |

Konner 2002. KI 62: 329-38.

# Vein diameter as predictor of AVF maturation (n = 298)

- functional maturation
  - successful cannulation of AVF; Qb 350-400 ml/min for 4 hrs or less
- primary failure
  - AVF abandonment prior to cannulation

| Risk factor | *P*-value | OR | 95% CI |
|---|---|---|---|
| age 65-99 yrs | 0.672 | 0.79 | 0.26 – 2.37 |
| gender | 0.254 | 0.52 | 0.17 – 1.60 |
| DM | 0.482 | 1.56 | 0.45 – 5.50 |
| HTN | 0.749 | 1.36 | 0.21 – 8.76 |
| largest vein size on DUS | 0.002 | 0.15 | 0.04 – 0.50 |
| BCAVF | 0.170 | 0.45 | 0.14 – 1.41 |

Lauvao 2009. J Vasc Surg 49: 1499-504.

# AVF creation and use in females

- 2yr retrospective study
  - 106 females, age 55.7 ± 18 yrs
  - 86 males, age 53.3 ± 15 yrs
- vascular mapping performed by Doppler US
- same rate of AVF creation and AVF in use between males and females
  - ? rates of primary failure

Caplin 2003. AJKD 41: 429-32

- frequency of creation/placement of AVF
- vessel size discrepancy
- adequacy rates
  - FTM; response to salvage procedures
  - other causes of failure
- patency/functionality

# Frequency of creation

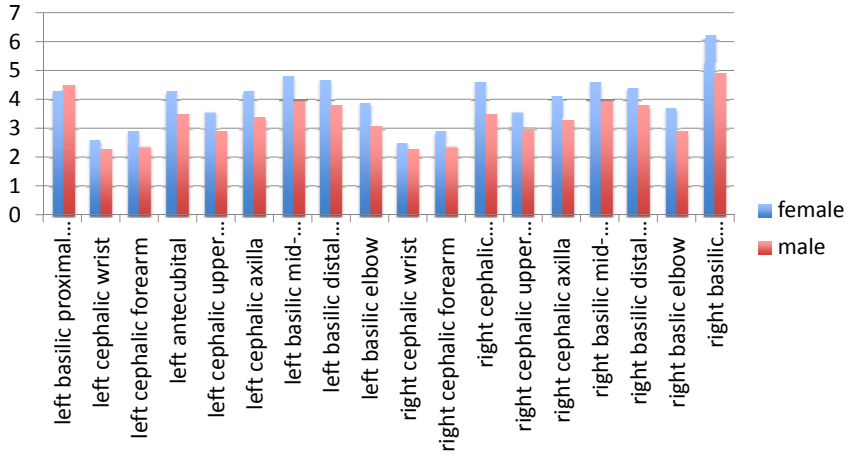
| | n | AVF | AVG |
|---|---|---|---|
| female | 75 | 43 (49%) | 29 (58%) |
| male | 65 | 44 (51%) | 21 (42%) |
| total | 140 | 87 | 50 |
| *P*-value | | 0.20 | 0.17 |

| | AVF (n = 212) | AVG (n = 621) | *P*-value |
|---|---|---|---|
| age | | | |
| 65-72 yrs | 54 (25.5%) | 174 (28%) | |
| ≥ 73 yrs | 47 (22.2%) | 167 (26.9%) | |
| women | 65 (30.1%) | 341 (54.9%) | < 0.001 |
| DM | 90 (42.5%) | 330 (53.1%) | < 0.01 |

Caplin 2003. AJKD 41: 429-32. Astor 2000. AJKD 36: 1126-34.

Are vessel sizes in females able to account for prevalence or outcome of AVF?

vein sizes by Doppler US
female vs. male




Caplin 2003. AJKD 41: 429-32.

## Pre-op vasc diameters for forearm and upper arm AVF, sorted by pt gender

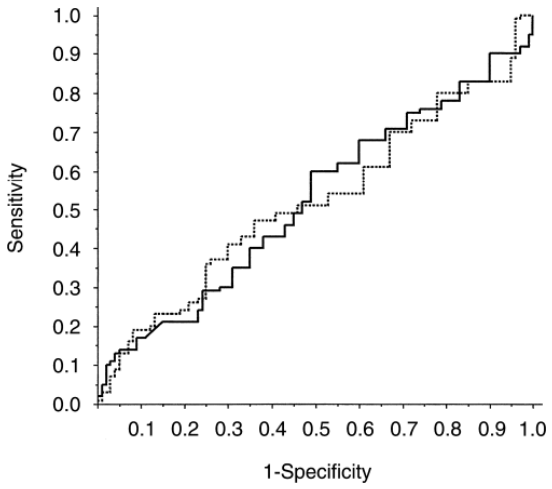
| | Female | Male | *P* value |
|---|---|---|---|
| Forearm fistula | | | |
| Artery diameter | 0.25±0.04 | 0.28±0.04 | 0.004 |
| Vein diameter | 0.29±0.04 | 0.30±0.04 | 0.34 |
| Upper arm fistula | | | |
| Artery diameter | 0.42±0.09 | 0.54±0.14 | <0.001 |
| Vein diameter | 0.41±0.11 | 0.41±0.14 | 0.90 |

Miller 2003. KI 63: 346-52

## Pre-op vascular diameters for forearm and upper arm AVF, sorted by outcome

| | Adequate fistula | Inadequate fistula | *P* value |
|---|---|---|---|
| Forearm fistula | | | |
| Artery diameter | 0.27±0.05 | 0.27±0.04 | 0.91 |
| Vein diameter | 0.30±0.05 | 0.29±0.04 | 0.07 |
| Upper arm fistula | | | |
| Artery diameter | 0.48±0.16 | 0.47±0.10 | 0.62 |
| Vein diameter | 0.42±0.13 | 0.40±0.11 | 0.51 |

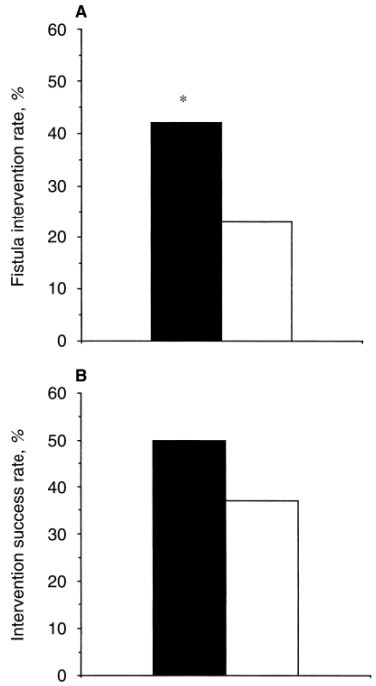
Miller 2003. KI 63: 346-52




ROC curve relating initial adequacy of AVF to pre-op arterial (solid line) and vein diameter (broken line)

Miller 2003. KI 63: 346-52

Are the adequacy, patency and functionality of the AVF different in females?




Intervention rate for immature AVF, after exclusion of technical failures and early thrombosis.

18/41 (44%) that underwent salvage intervention achieved adequacy for dialysis

■ female □ male $P < 0.05$

Likelihood of AVF adequacy for dialysis after salvage procedures is equal for males and females.

Miller 2003. KI 63: 346-52

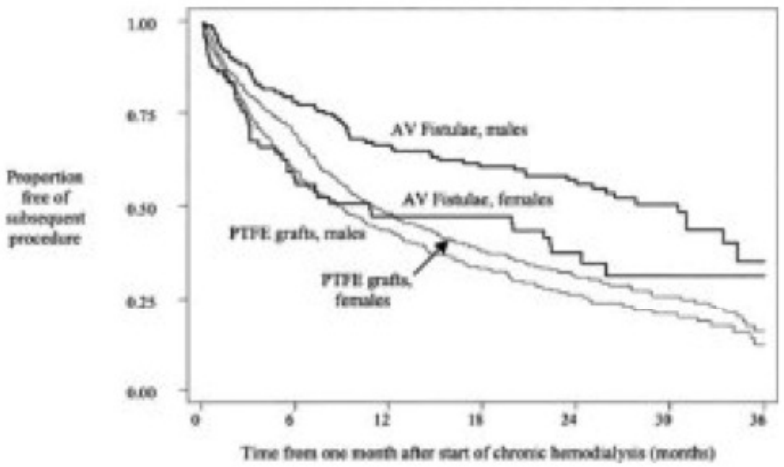
# Overall AVF outcomes males vs. females

| | Female | Male | All pts |
|---|---|---|---|
| Adequate | 27 (32%) | 53 (50.5%) | 80 (42%) |
| Adequate without interv | 16 (19%) | 46 (44%) | 62 (33%) |
| Adequate after interv | 11 (13%) | 7 (6.5%) | 18 (9%) |
| Not adequate | 57 (68%) | 52 (49.5%) | 109 (58%) |
| Technical failure | 11 (13%) | 3 (3%) | 14 (7%) |
| Early thrombosis | 21 (25%) | 20 (19%) | 41 (22%) |
| Failure to mature | 25 (30%) | 29 (27.5%) | 54 (29%) |
| Total | 84 | 105 | 189 |

$P = 0.001$ for differences in outcomes between men and women

Miller 2003. KI 63: 346-52

## Kaplan-Meier estimates of freedom from 1st subsequent access procedure




Astor 2000. AJKD 36: 1126-34.

## Incidence rate per access-year of 1st subsequent access procedure in incident pts with permanent access in use 1 month after initiation of chronic hemodialysis

| | Age Quartile | | | | Overall |
|---|---|---|---|---|---|
| | 1 (18-54y) | 2 (55-64y) | 3 (65-72y) | 4 (≥73y) | |
| Male | | | | | |
| AVF (n=147) | 0.29 (0.19-0.43) | 0.28 (0.16-0.50) | 0.29 (0.18-0.48) | 0.58 (0.36-0.94) | 0.33 (0.26-0.42) |
| PTFE AVG (n=280) | 0.99 (0.77-1.28) | 0.72 (0.53-0.98) | 0.83 (0.64-1.08) | 0.65 (0.49-0.86) | 0.79 (0.69-0.91) |
| *P*-value | < 0.001 | < 0.001 | < 0.001 | 0.67 | < 0.001 |
| Female | | | | | |
| AVF (n=65) | 0.41 (0.21-0.83) | 0.52 (0.29-0.95) | 0.60 (0.32-1.11) | 0.96 (0.55-1.69) | 0.59 (0.43-0.80) |
| PTFE AVG (n=341) | 0.70 (0.53-0.92) | 0.55 (0.42-0.71) | 0.78 (0.62-0.98) | 0.60 (0.46-0.78) | 0.65 (0.57-0.74) |
| *P*-value | 0.21 | 0.34 | 0.14 | 0.14 | 0.74 |

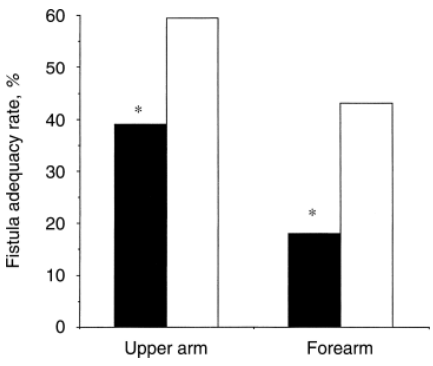
Astor 2000. AJKD 36: 1126-34.

# Gender and AVF

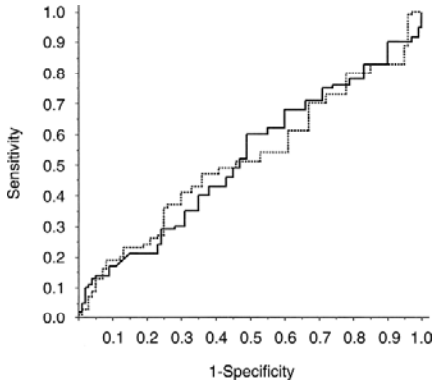
- retrospective analysis
- pre-operative sonographic mapping done in >90% of cases
  - AVG placed if findings precluded AVF creation
- 189 patients with mean age 54 ± 14 yrs
- not adequate
  - technical failure: vessels deemed unsuitable during exploration or thrombosis within 24h
  - early thrombosis: within 8 wks of placement
  - FTM: inability to achieve adequacy within 6 months in the absence of technical failure or early thrombosis

Miller 2003. KI 63: 346-52.

# Gender and AVF




■ female □ male $P < 0.05$




ROC curve relating initial adequacy of AVF to pre-op arterial (solid line) and vein diam (broken line)

Miller 2003. KI 63: 346-52.

# AVF

- higher rates of inadequate AVF
  - higher technical failure rates
  - higher early (within 8 wks of creation) thrombosis
- salvage procedures required more frequently
- not explained on the difference of vessel caliber
- need more data on long-term survival (ie, 2$^{o}$ patency rates) and # of procedures needed to achieve survival

# OR of factors associated with AVF failure to mature

| Covariates | *P*-value | aOR | 95% CI |
|---|---|---|---|
| BMI (kg/m2) | | | |
| < 30 | reference | | |
| ≥ 30 | 0.33 | 1.52 | 0.66 – 3.48 |
| Age (per year) | 0.81 | 1.00 | 0.98 – 1.03 |
| Gender (female) | 0.80 | 0.90 | 0.40 – 2.02 |
| Black ethnicity (vs. non-black) | 0.16 | 1.73 | 0.81 – 3.72 |
| Co-morbidities | | | |
| PVD | 0.81 | 1.13 | 0.44 – 2.89 |
| DM | 0.28 | 1.49 | 0.73 – 3.07 |

Chan 2008. Semin Dialy 21: 274-9.

# OR of factors associated with AVF requirement for revision

| Covariates | *P*-value | aOR | 95% CI |
|---|---|---|---|
| BMI (kg/m2) | | | |
| < 30 | reference | | |
| ≥ 30 | 0.18 | 0.35 | 0.08 – 1.59 |
| Age (per year) | 0.08 | 1.03 | 1.00 – 1.06 |
| Gender (female) | 0.18 | 1.84 | 0.76 – 4.45 |
| Black ethnicity (vs. non-black) | 0.79 | 0.87 | 0.30 – 2.48 |
| Co-morbidities | | | |
| PVD | 0.94 | 1.04 | 0.34 – 3.16 |
| DM | 0.57 | 0.77 | 0.32 – 1.87 |

Chan 2008. Semin Dialy 21: 274-9.

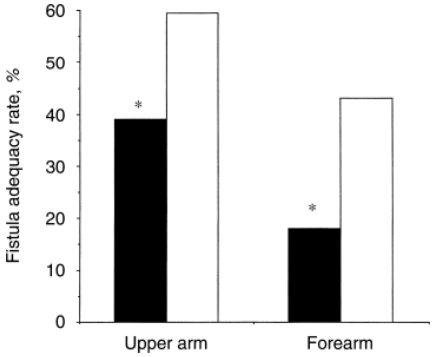
# factors affecting RC AVF patency

| Factor | HR | 95% CI | *P*-value |
|---|---|---|---|
| 1° patency | | | |
| female gender | 1.657 | 1.246 - 2.205 | 0.001 |
| prior HD | 1.331 | 1.007 - 1.759 | 0.031 |
| 2° patency | | | |
| female gender | 1.625 | 1.220 - 2.164 | 0.001 |
| prior HD | 1.359 | 1.026 - 1.801 | 0.033 |

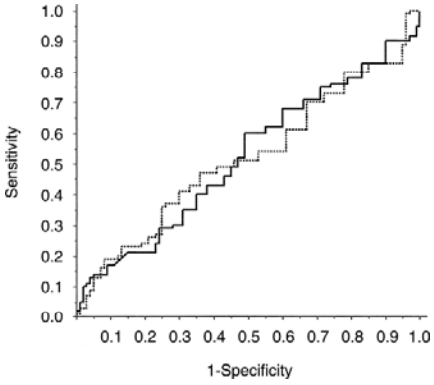
Age group did <u>not</u> influence loss of primary or secondary function.

Weale 2008. J Vasc Surg 47: 144-50.

# Gender and AVF




■ female □ male $P < 0.05$

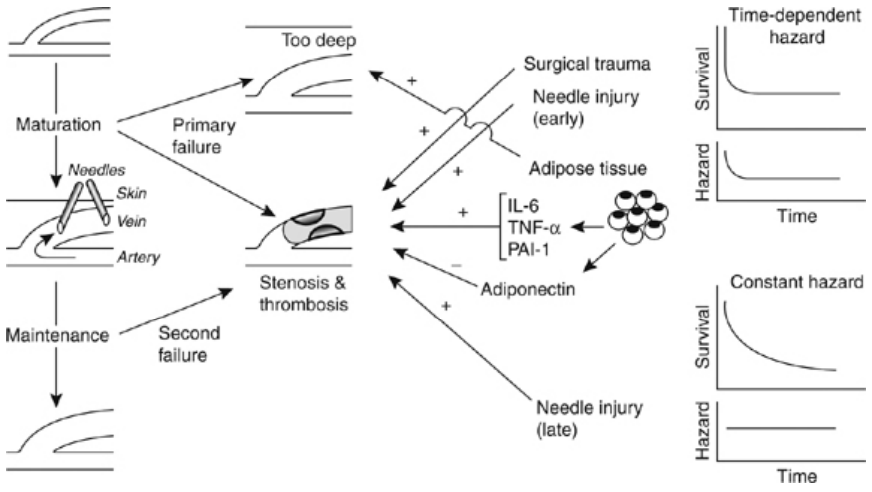



ROC curve relating initial adequacy of AVF to pre-op arterial (solid line) and vein diam (broken line)

Miller 2003. KI 63: 346-52.

# AVF and obesity

# Obesity and fistula failure




Dixon 2007. KI 71: 12-14.

# Likelihood of adequate new AVF with pre-operative mapping

| | *n* AVF | *n* adequate | % adequate | OR | 95% CI | *P* value |
|---|---|---|---|---|---|---|
| Age | | | | | | |
| ≥ 65 yrs | 12 | 5 | 42% | 0.57 | 0.17 – 1.97 | 0.37 |
| < 65 yrs | 72 | 40 | 56% | | | |
| Gender | | | | | | |
| female | 36 | 16 | 44% | 0.52 | 0.22 – 1.26 | 0.15 |
| male | 48 | 29 | 60% | | | |
| BMI | | | | | | |
| ≥ 27 kg/m2 | 31 | 16 | 52% | 0.79 | 0.32 – 1.97 | 0.61 |
| < 27 kg/m2 | 47 | 27 | 57% | | | |

Allon 2001. KI 60: 2013-20.

Overall success rate in achieving useable AVF when pre-operative vascular mapping is used

| | % of pts with AVF placed | % of AVF that were useable | % of all pts with useable AVF |
|---|---|---|---|
| All patients | 0.64 | 0.54 | 0.34 |
| Gender | | | |
| female | 0.50 | 0.44 | 0.22 |
| male | 0.74 | 0.60 | 0.44 |
| Age | | | |
| ≥ 65 yrs | 0.62 | 0.42 | 0.26 |
| < 65 yrs | 0.64 | 0.56 | 0.36 |
| BMI | | | |
| ≥ 27 kg/m2 | 0.68 | 0.52 | 0.35 |
| < 27 kg/m2 | 0.60 | 0.57 | 0.34 |

Allon 2001. KI 60: 2013-20.

# Obesity and AVF

- prospective observational study of first AV access over 2 yr period
- vascular mapping performed on all patients
- 183 first AVF vs. 205 first AVG

Kats 2007. KI 71: 39-43.

# AVF vs. AVG

| | AVF | AVG | *P*-value |
|---|---|---|---|
| n | 183 | 205 | - |
| age | 55 ± 14 | 55 ± 15 | 0.71 |
| Gender | | | 0.007 |
| male | 109 (60%) | 94 (64%) | |
| female | 74 (40%) | 111 (54%) | |
| Race | | | 0.01 |
| black | 139 (76%) | 178 (87%) | |
| white | 42 (24%) | 27 (13%) | |
| DM | | | 0.56 |
| yes | 107 (58%) | 112 (55%) | |
| no | 79 (42%) | 93 (45%) | |

Kats 2007. KI 71: 39-43.

# AVF vs. AVG

| | AVF | AVG | *P*-value |
|---|---|---|---|
| n | 183 | 205 | |
| CAD | | | 0.12 |
| yes | 55 (30%) | 77 (38%) | |
| no | 128 (70%) | 128 (62%) | |
| PVD | | | 0.86 |
| yes | 23 (12%) | 27 (13%) | |
| no | 160 (88%) | 178 (87%) | |
| BMI | | | 0.96 |
| ≥ 30 kg/m2 | 54 (30%) | 60 (29%) | |
| < 30 kg/m2 | 129 (70%) | 145 (71%) | |

Kats 2007. KI 71: 39-43.

# AVF in obese vs. non-obese

| | obese | non-obese | *P*-value |
|---|---|---|---|
| n | 54 (29.5%) | 129 (70.5%) | |
| age | 56 ± 12 | 56 ± 16 | 0.92 |
| gender | | | 0.09 |
| male | 27 (50%) | 82 (64%) | |
| female | 27 (50%) | 47 (36%) | |
| race | | | 0.17 |
| black | 45 (83%) | 94 (73%) | |
| white | 9 (17%) | 33 (27%) | |
| DM | | | 0.0007 |
| yes | 41 (76%) | 63 (49%) | |
| no | 13 (24%) | 66 (51%) | |

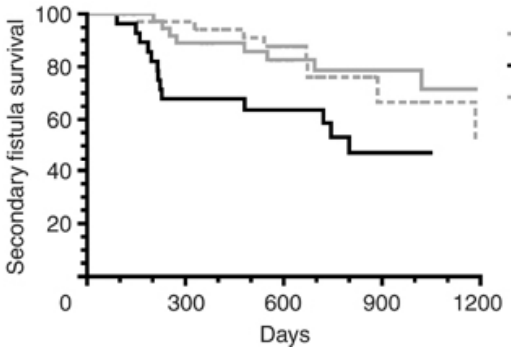
Kats 2007. KI 71: 39-43.

| | obese | non-obese | *P*-value |
|---|---|---|---|
| n | 54 (29.5%) | 129 (70.5%) | |
| CAD | | | 0.25 |
| yes | 13 (24%) | 42 (33%) | |
| no | 46 (85%) | 114 (88%) | |
| PVD | | | 0.55 |
| yes | 8 (15%) | 15 (12%) | |
| no | 46 (85%) | 114 (88%) | |
| pre-HD? | | | 0.33 |
| yes | 26 (48%) | 52 (40%) | |
| no | 28 (52%) | 77 (60%) | |
| AVF location | | | 0.90 |
| forearm | 29 (54%) | 68 (53%) | |
| upper arm | 25 (46%) | 61 (47%) | |
| vein transposition | | | 0.45 |
| yes | 8 (15%) | 14 (11%) | |
| no | 46 (85%) | 115 (89%) | |

Kats 2007. KI 71: 39-43.

# 1st AVF outcomes

| | Obese | Non-obese |
|---|---|---|
| n | 54 | 129 |
| successful use ≥ 1 month | 29 (54%) | 76 (59%) |
| primary failure | 25 (46%) | 53 (41%) |




| | HR | 95% CI | *P*-value |
|---|---|---|---|
| overweight | 1.13 | 0.42-3.06 | 0.80 |
| obese | 2.74 | 1.48-7.90 | 0.004 |

Kats 2007. KI 71: 39-43.

# OR of factors associated with AVF failure to mature

| Covariates | *P*-value | aOR | 95% CI |
|---|---|---|---|
| BMI (kg/m2) | | | |
| < 30 | reference | | |
| ≥ 30 | 0.33 | 1.52 | 0.66 – 3.48 |
| Age (per year) | 0.81 | 1.00 | 0.98 – 1.03 |
| Gender (female) | 0.80 | 0.90 | 0.40 – 2.02 |
| Black ethnicity (vs. non-black) | 0.16 | 1.73 | 0.81 – 3.72 |
| Co-morbidities | | | |
| PVD | 0.81 | 1.13 | 0.44 – 2.89 |
| DM | 0.28 | 1.49 | 0.73 – 3.07 |

Chan 2008. Semin Dialy 21: 274-9.

# OR of factors associated with AVF requirement for revision

| Covariates | *P*-value | aOR | 95% CI |
|---|---|---|---|
| BMI (kg/m2) | | | |
| < 30 | reference | | |
| ≥ 30 | 0.18 | 0.35 | 0.08 – 1.59 |
| Age (per year) | 0.08 | 1.03 | 1.00 – 1.06 |
| Gender (female) | 0.18 | 1.84 | 0.76 – 4.45 |
| Black ethnicity (vs. non-black) | 0.79 | 0.87 | 0.30 – 2.48 |
| Co-morbidities | | | |
| PVD | 0.94 | 1.04 | 0.34 – 3.16 |
| DM | 0.57 | 0.77 | 0.32 – 1.87 |

Chan 2008. Semin Dialy 21: 274-9.

# Conclusion

- AVFs should continue to be the access of choice in all suitable patients.
  - Failure to mature with catheter-dependency remains a major obstacle.
- Dialysis catheters should continue to be avoided whenever reasonable.
- Clinical decision-making must be individualized.

Patient first
Catheter last
Fistula best