# Arterio veneuse fistel voor hemodialyse (VA)

Levensader van de dialyse patient

# MONITORING VAN HET VAATACCESS

- Inleiding
- DOQI guidelines
  - Creatie van meer natieve fistels
  - Monitoring VA
    - Kliniek
    - Recirculatie
    - Drukmetingen
    - Flowmetingen

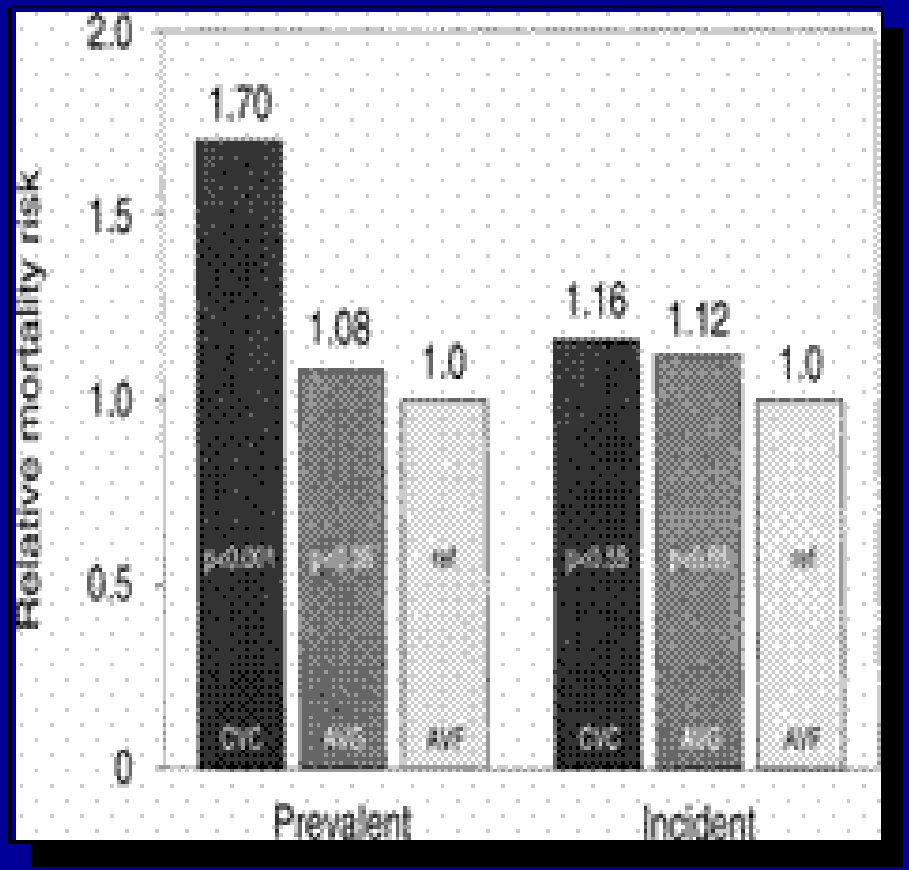
# Inleiding:
# De VA stelt meer eisen!

- Aantal patienten in dialyse neemt toe: meer vascular access morbiditeit
- Patienten overleven langer in dialyse: meer vasculair accessen nodig
- Vooral oudere patienten, vaak met een belangrijke comorbiditeit

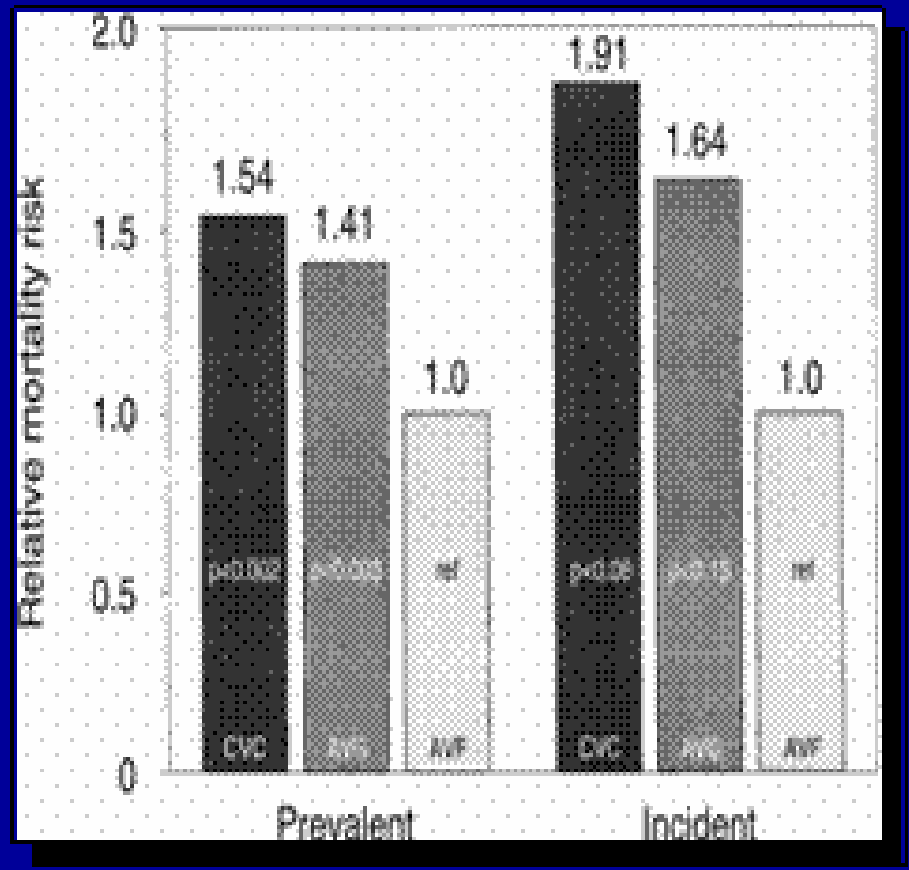
# Inleiding:
# VA en VA is twee

- Natieve fistels
- Transposities
- Grafts
- Permanente catheter

# Access Type and Mortality Risk

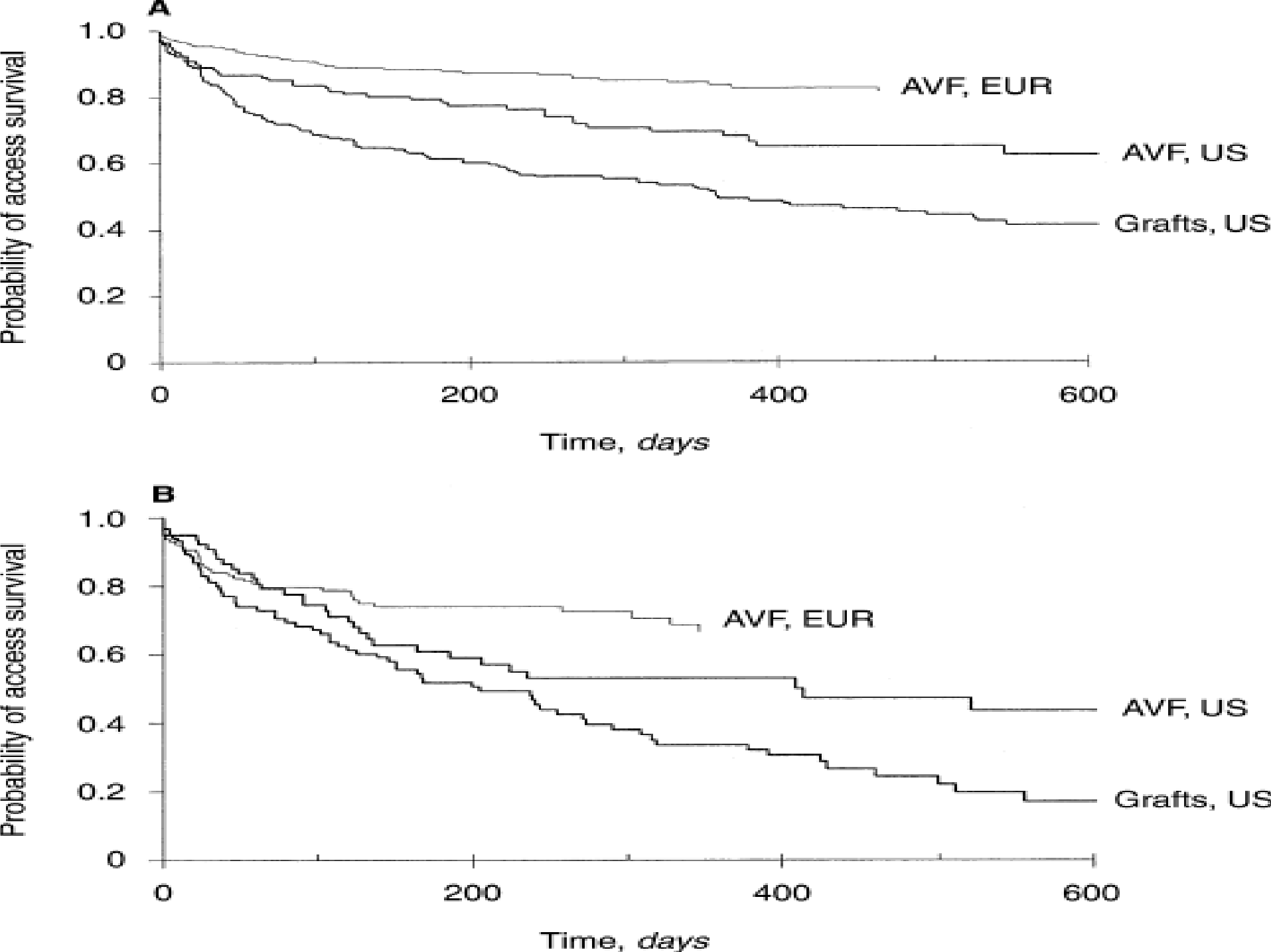



**Non-Diabetics**




**Diabetics**

*R Dhingra et al Kidney International 60 (4), 1443-1451.*


A
Probability of access survival
1.0
0.8
0.6
0.4
0.2
0
AVF, EUR
AVF, US
Grafts, US
0
200
400
600
Time, days
B
Probability of access survival
1.0
0.8
0.6
0.4
0.2
0
AVF, EUR
AVF, US
Grafts, US
0
200
400
600
Time, days

# Inleiding:
# VA complicaties

- AVF:
  - Bewaarde endotheliale functie, vorming van collateralen
  - 85-95% 1 year prim patency
- >Thrombosis
  - failure to mature or early thrombosis 25-70%
  - 0.5 episodes of thrombosis/ pt year (DOQI 0.25)
- <Aneurysmata
- <<Infection
  - 1-4%  (Doqi:<1%)

# Inleiding: Complicaties bij AVG's

## 16-25% van al de hospitaal verblijven van dialyse patienten

- In AVG
  - 10-20 × meer complicaties , ernstiger complicaties
  - prim patency 23%, sec patency 65-90%
  - 2.5 interventions/year
  - >>thrombosis
    - initial failure rate 5-15%
    - due to stenosis (1.2-1.4 events/year: Doqi:0.5)
  - >infection 11-20% (Doqi<10%)

National Kidney Foundation

DOQI™

Dialysis Outcomes Quality Initiative

# CLINICAL PRACTICE GUIDELINES

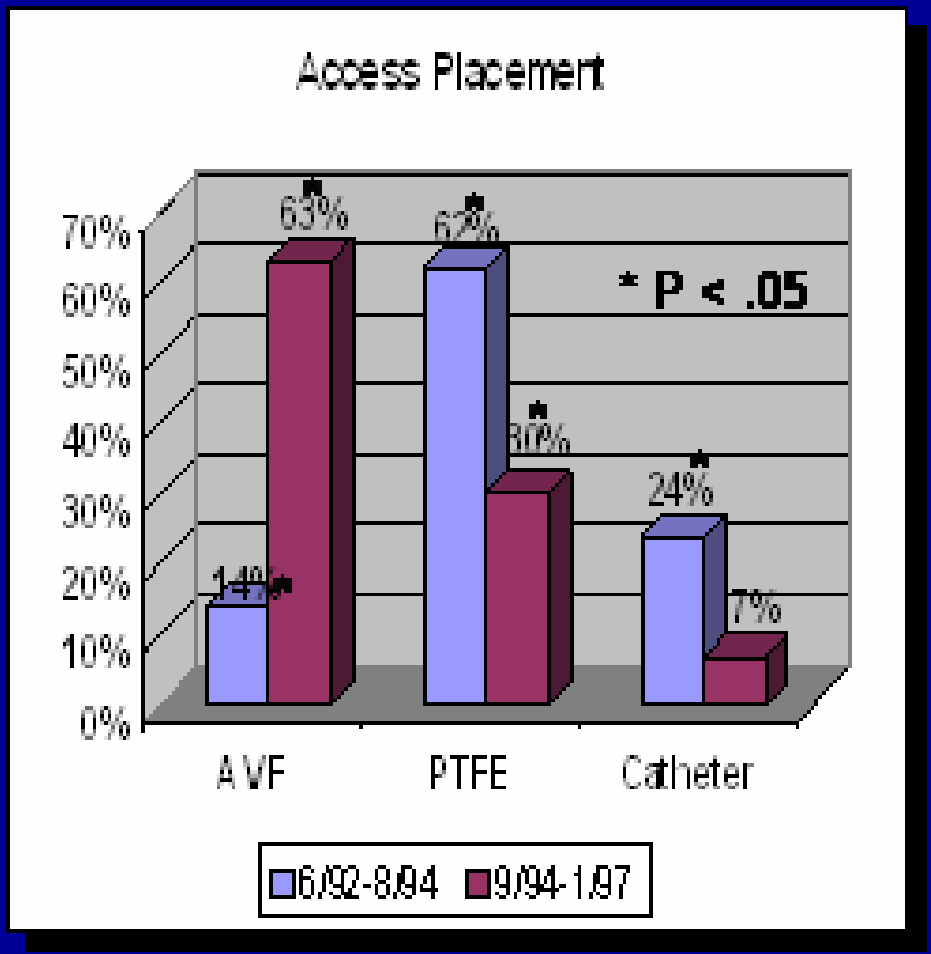
## *For Vascular Access*

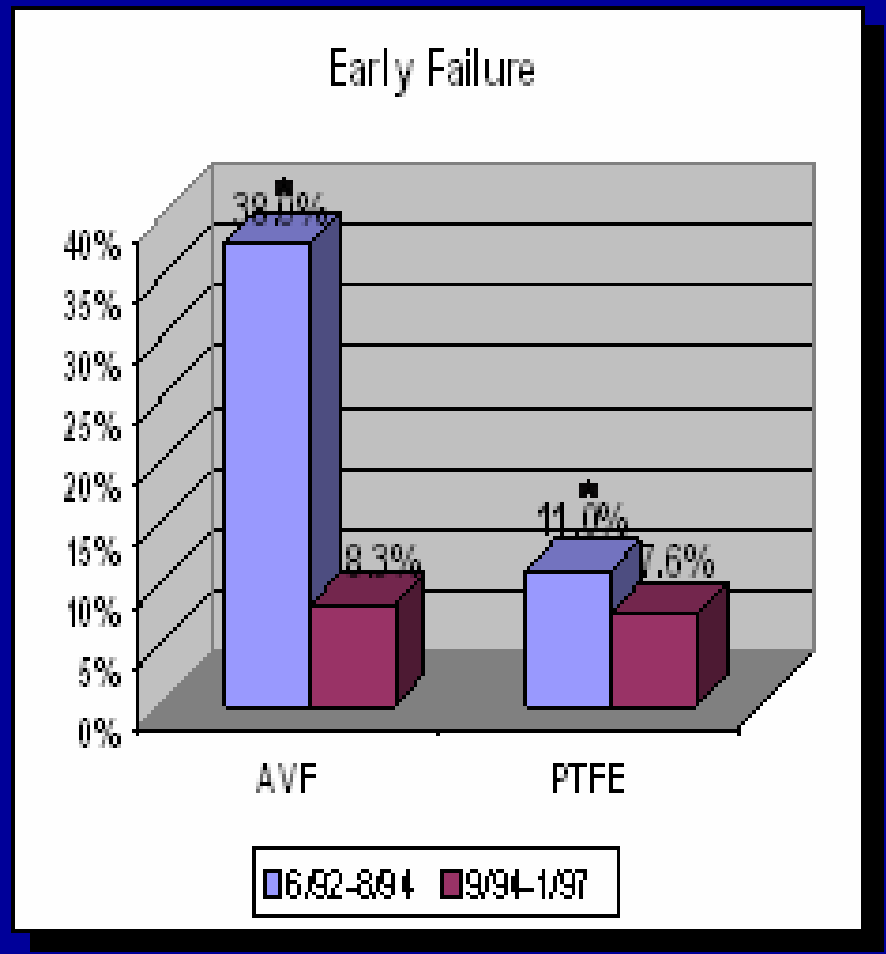
Final Report from the Vascular Access Work Group of the
National Kidney Foundation — Dialysis Outcomes Quality Initiative

# DOQI Guidelines

- Creatie van meer natieve fistels
- Monitoring VA functie
  - om tijdig dysfunctie op te sporen en herstel van de VA mogelijk te maken vooraleer de VA thromboseert

# Preoperative Imaging for AVF Placement




*M Silva et al; J Vasc Surg 1998; 27: 302-8*

# Sparen van armvenen!

**ATTENTIE voor armvenen**

**Gelieve bij het afnemen van een bloedstaal zoveel als mogelijk de handrug bloedvaten te gebruiken. Mr/Mevr…… lijdt aan chronische nierinsufficientie. Het is belangrijk om de voorarm en elleboog venen te sparen om in de toekomst de creatie van arterioveneuse fistels als vaataccess voor hemodialyse toe te laten.**

**Dienst nierziekten ZNA, Antwerpen.**
**telefoon**

# MonitoringVA

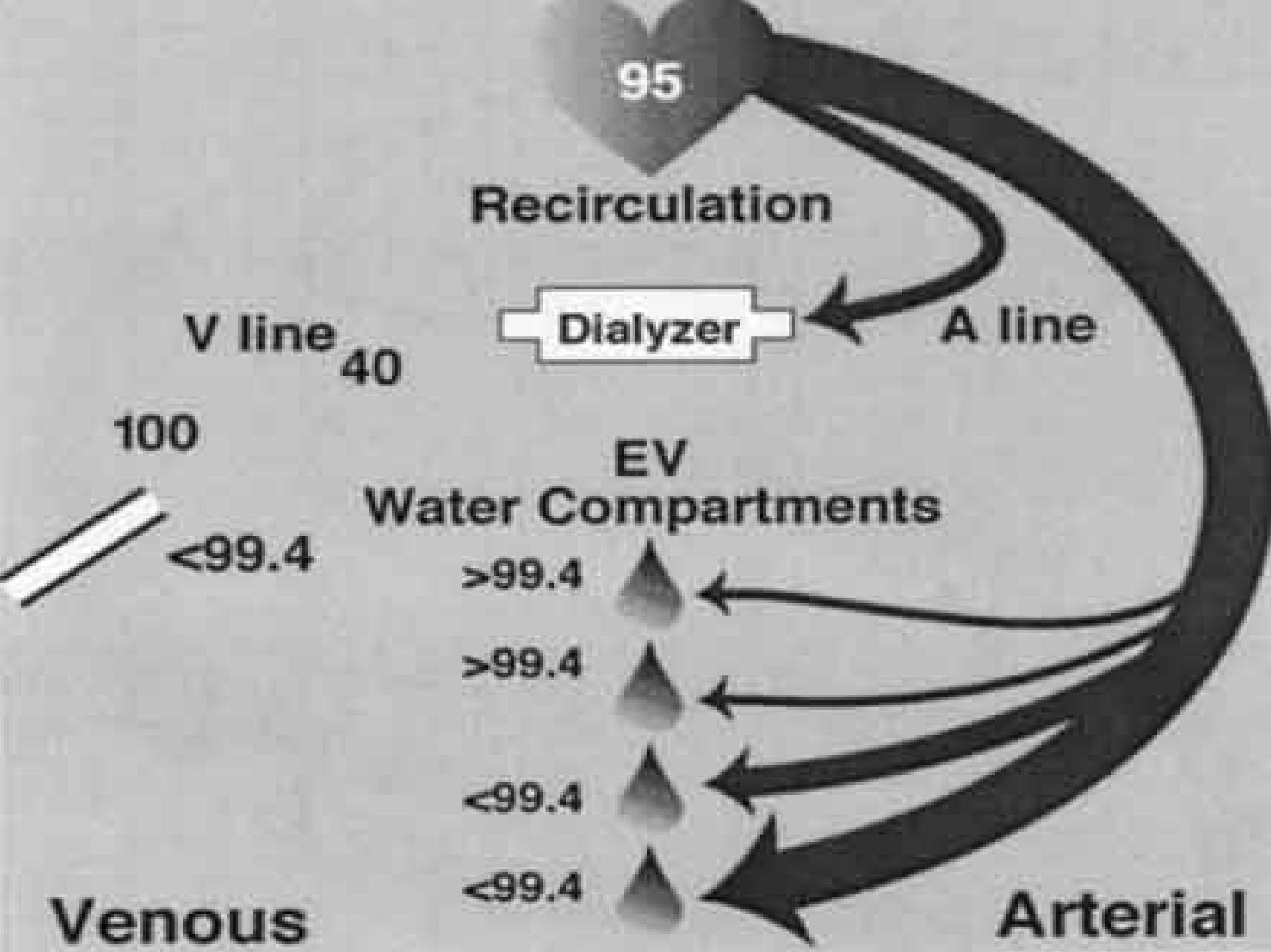
- Klinisch onderzoek
- Access recirculatie
- Monitoren van veneuse drukken (Dynamische, Statische)
- Access flow monitoring (Dopler, ultrasound dilution, differential conductivity method, optical Hct method)

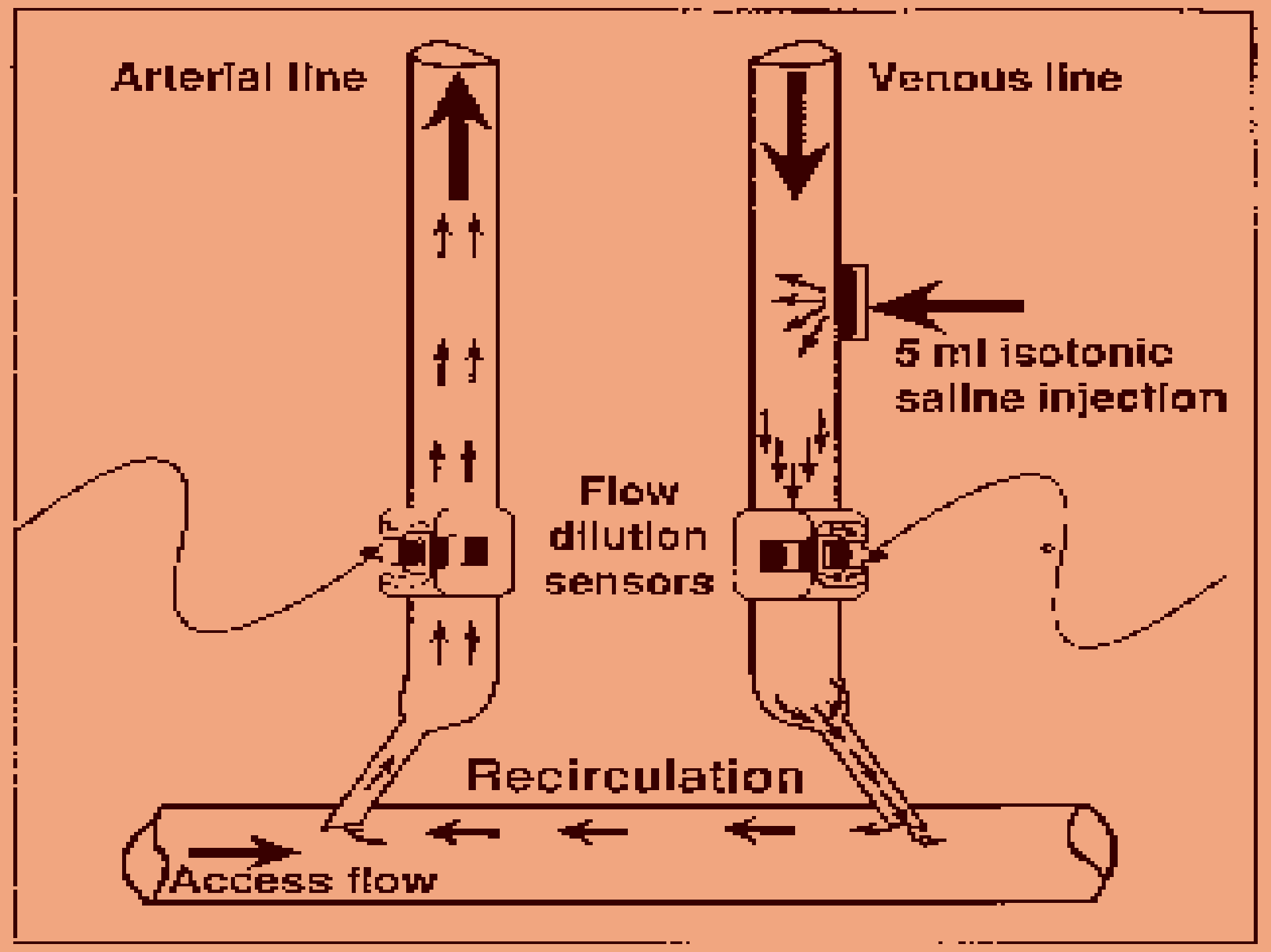
# Klinische evaluatie

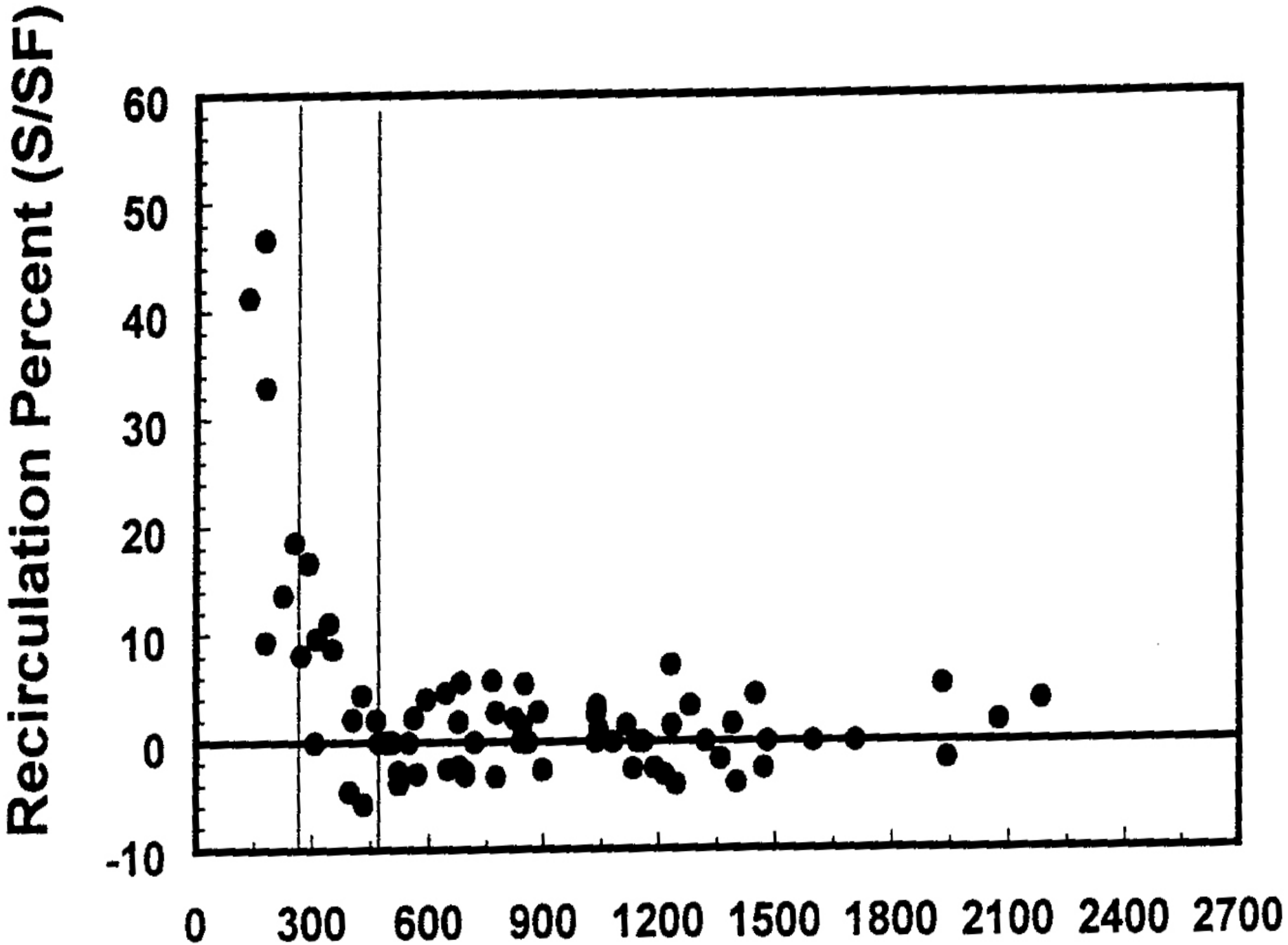
- Klinische bevindingen
  - Veranderingen in puls of thrill
  - Zwellen van de arm
  - Ontwikkelen van collateralen
  - Lang nabloeden
- laattijdig
- Wijzen op stenose, doch niet of stenose tot thrombose gaat lijden

# VA recirculatie

- Op Urea meting gebaseerde methode: RC=(S-A/S-V)X100
  - 3 naald methode is een overschatting ( cardiopulmonale recirculatie, venoveneus disequilibrium), veneuse prik nodig
  - 2 naald methode >10%
- Dilutie methode
  - Meest correcte methode
  - >5%


95
Recirculation
Dialyzer
V line
40
A line
100
EV
Water Compartments
<99.4
>99.4
>99.4
<99.4
<99.4
Venous
Arterial


Arterial line
Venous line
5 ml isotonic saline injection
Flow dilution sensors
Recirculation
Access flow


Recirculation Percent (S/SF)
60
50
40
30
20
10
0
-10
0
300
600
900
1200
1500
1800
2100
2400
2700

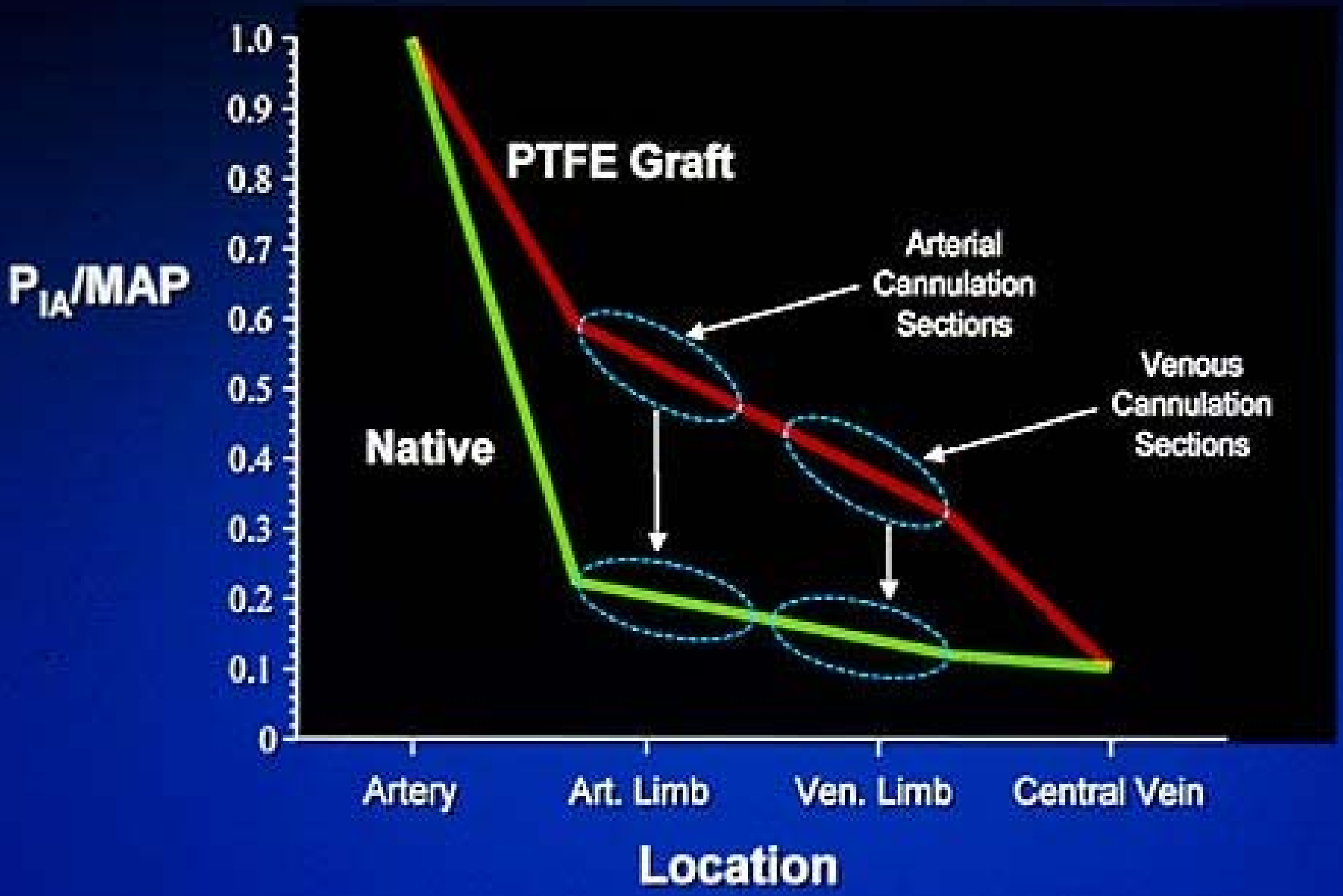
# Access Recirculatie doet zich enkel voor wanneer de fistel bloed flow lager is dan de pomp flow

- Late manifestatie van VA dysfuctie
- De meeste  PTFE's zijn gethromboseerd vooraleer RC zich voordoet
- Zinvol bij de eerste maal aanprikken
- in AVF's als de flow laag is (pitfall:stenosis tussen de naalden)

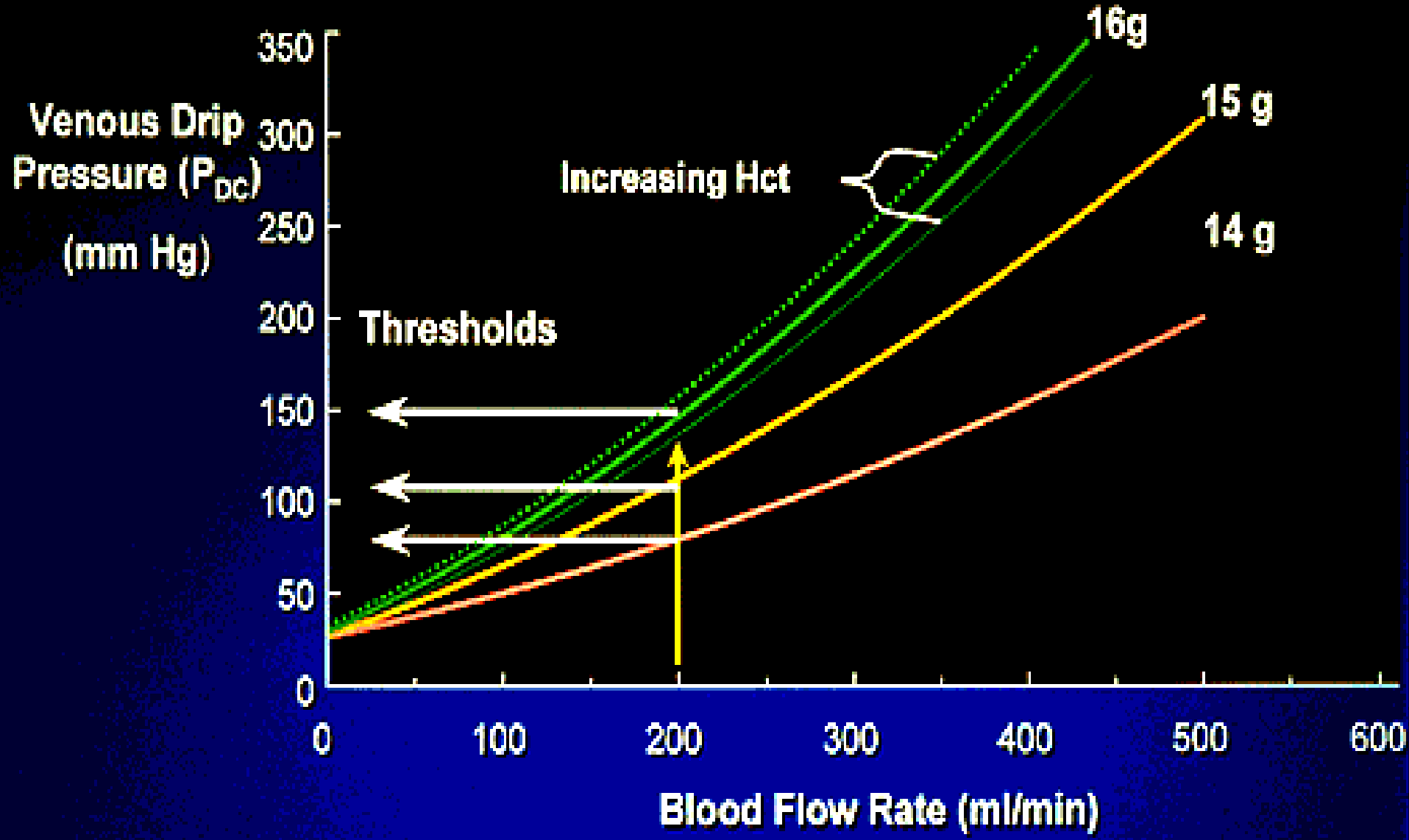
# Veneuse druk Monitoring

- Dynamische veneuse druk monitoring
- Statische veneuse druk monitoring

# Intra-Access Pressure Profiles



# Dynamic Pressure Monitoring




(Adapted from Schwab et al, Besarab et a, Sullivan et al)

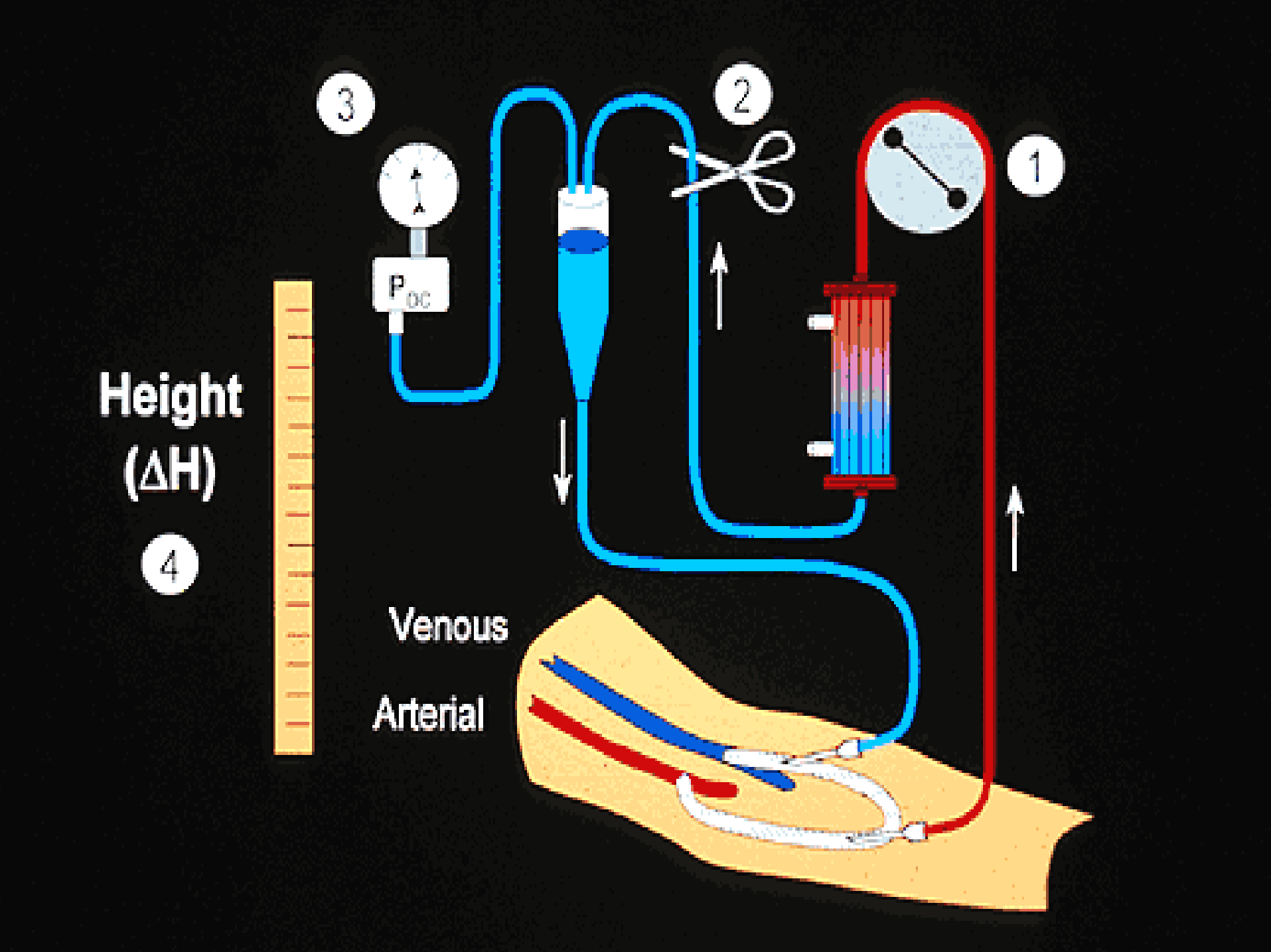

3
2
1
$P_{OC}$
Height
(ΔH)
4
Venous
Arterial

**Table 1.** Results of pressure and flow measurements and calculation of resistances in patients without (Group A, $N = 39$) and with (Group B, $N = 31$) an angiographically documented stenosis in the venous outflow tract

| | No graft stenosis (group A) | | Graft stenosis (group B) | | |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Significance |
| VP200 *mm Hg* | 95 | 22 | 126 | 35 | < 0.001 |
| VP0 *mm Hg* | 26 | 21 | 49 | 27 | < 0.001 |
| Flow *ml/min* | 1061 | 541 | 664 | 389 | = 0.002 |
| Relative outflow resistance | 0.315 | 0.165 | 0.537 | 0.187 | < 0.001 |
| Mean blood pressure *mm Hg* | 95 | 20 | 88 | 21 | NS |
| Graft resistance *U* | 0.153 | 0.214 | 0.192 | 0.133 | = 0.011 |
| Inflow resistance *U* | 0.111 | 0.160 | 0.088 | 0.074 | NS |
| Outflow resistance *U* | 0.043 | 0.066 | 0.104 | 0.095 | < 0.001 |

Significance indicates the *P* values of the differences between Groups A and B.

| | Thrombosis | No thrombosis |
|---|---|---|
| Sex *% male/female* | 36/64 | 43/56 |
| Race *% AA/White* | 48/52 | 54/46 |
| Access flow (Dilution) *ml/min* | 875 ± 426[a] | 1193 ± 677 |
| Access flow (Doppler) *ml/min* | 762 ± 420[a] | 1171 ± 657 |
| Venous pressure *mm Hg* | | |
| Qb @ 200 ml/min | 98 ± 97 | 97 ± 25 |
| Qb @ 300 ml/min | 147 ± 32 | 148 ± 33 |
| Qb @ 400 ml/min | 207 ± 33 | 203 ± 34 |
| Arterial pressure *mm Hg* | | |
| Qb @ 200 ml/min | −39 ± 27 | −42 ± 21 |
| Qb @ 300 ml/min | −100 ± 22 | −101 ± 34 |
| Qb @ 400 ml/min | −182 ± 34 | −176 ± 41 |
| Percent recirculation | 4.9 ± 4.8 | 5.2 ± 4.1 |

[a] $P = 0.001$ versus no thrombosis

# Veneuse drukmetingen

- Niet bruikbaar in natieve fistels
  - Bewaarde endotheel functie
  - Vorming van collateralen
- In grafts: kan wijzen op stenose, doch zegt niet of stenose significant de flow reduceert met thrombose risico voor gevolg

# Access flow (Qa) as screenings method?

# Access flow Qa

- Duplex ultrasound and Color Flow Doppler
- MRI angiography
- Ultrasound dilution technique (Transonic Systems)
- Optical dilution technique (In-Line diagnostics)
- Differential conductivity method

# Doppler Ultrasound VA

- Flow meting operator en locatie dependent
- Detectie stenose: Sensitiviteit 94% en specificiteit 98%
- In goed functionerende fistels : in 64% stenosis aangetroffen!
- Detectie stenose geen goede predictor voor thrombose
- Kan de interventionele radioloog wel leiden

# Measuring Access Flow

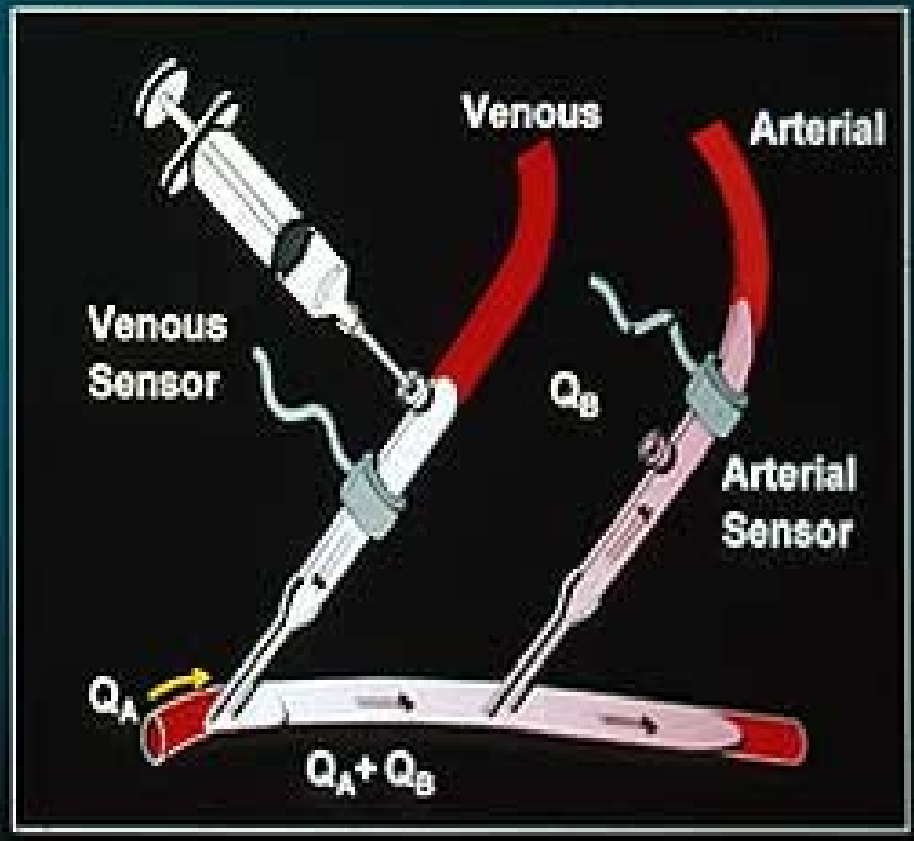
Indicator Dilution (Fick principle)

**Flow = Amount injected / AUC**

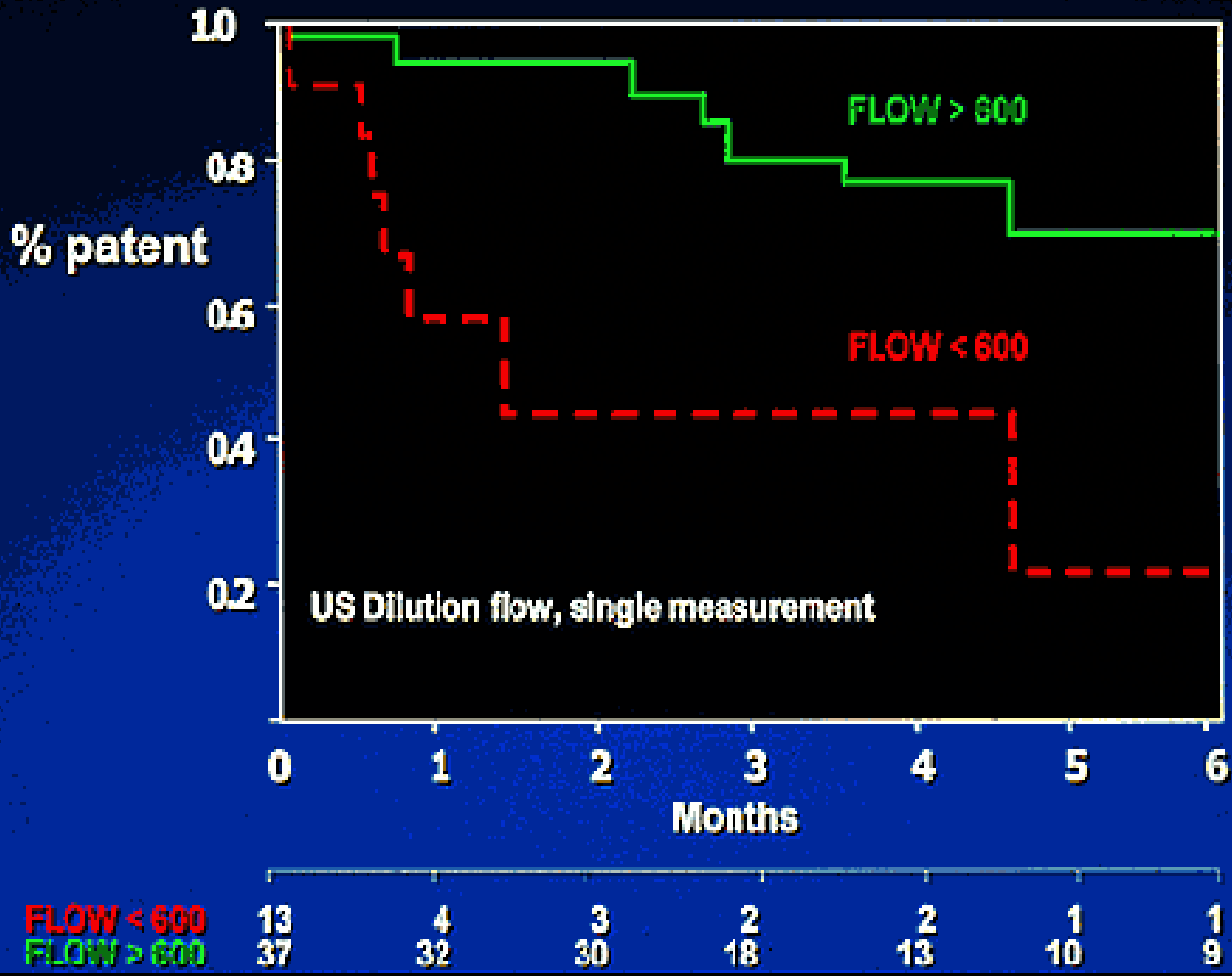
**Transonic Ultrasound Velocity (Krivitsky) Method:**

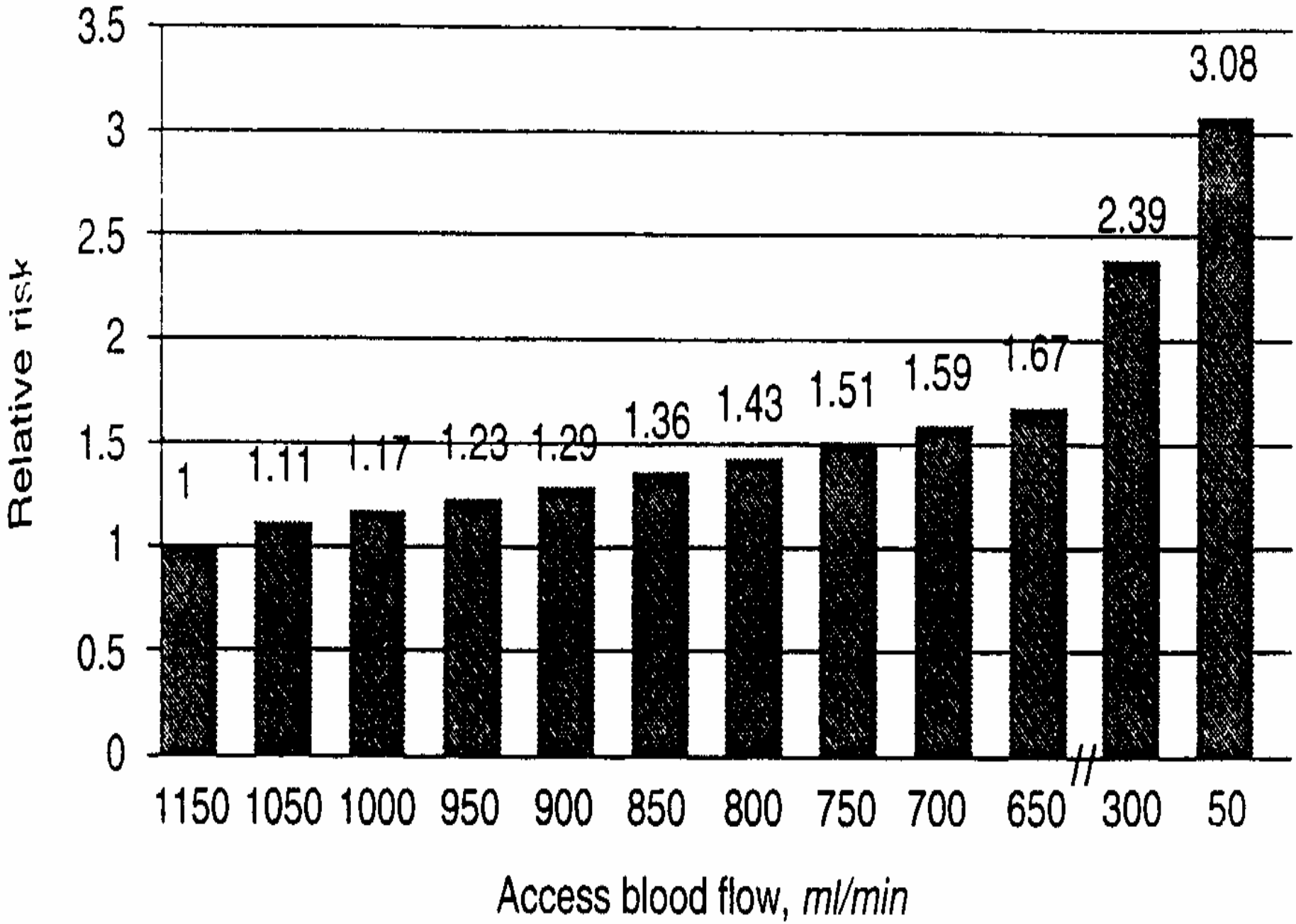
**Dual sensors obviate need for a calibration injection**

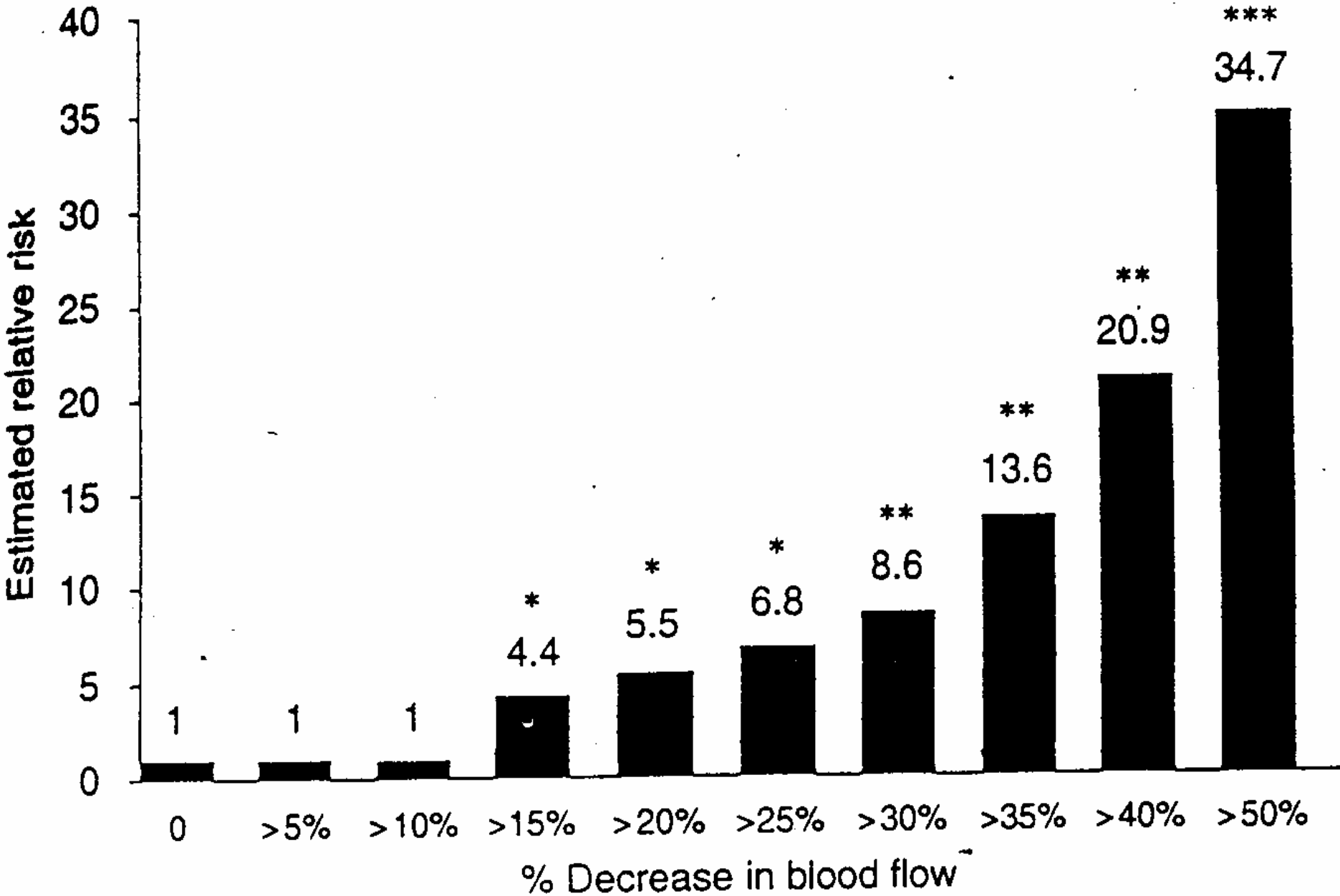
**Same sensor that calibrates the injection is used to measure blood pump flow**



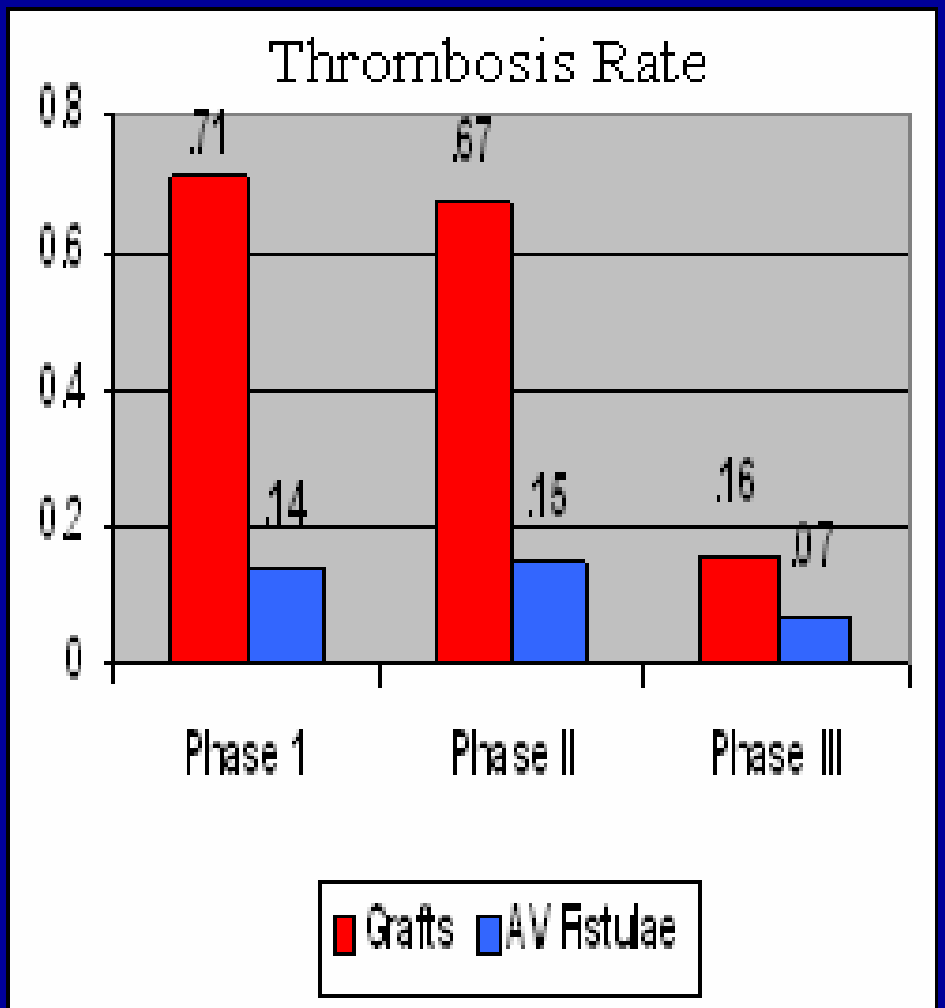
# Effect of Access Blood Flow on Graft Patency

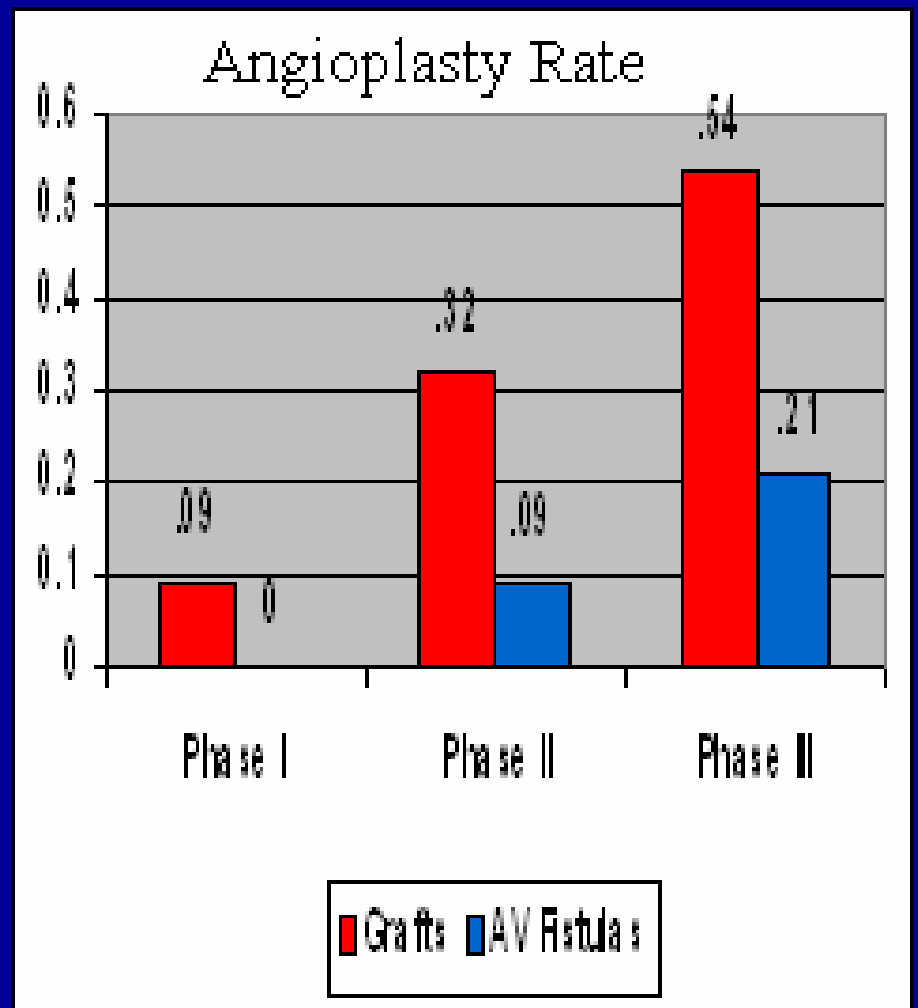



Relative risk
3.5
3
2.5
2
1.5
1
0.5
0
1
1.11
1.17
1.23
1.29
1.36
1.43
1.51
1.59
1.67
2.39
3.08
1150
1050
1000
950
900
850
800
750
700
650
300
50
Access blood flow, ml/min


Estimated relative risk
40
35
30
25
20
15
10
5
0
1
1
1
*
4.4
*
5.5
*
6.8
**
8.6
**
13.6
**
20.9
***
34.7
0
>5%
>10%
>15%
>20%
>25%
>30%
>35%
>40%
>50%
% Decrease in blood flow

# Monitoring & Intervention




*McCarley et al: Kidney International, Vol. 60 (2001), pp. 1164-1172*

**Table 2.** Adjusted yearly charges for thrombosis-related access care for patients with grafts and fistulas

| | Grafts | | | Fistulae | | |
|---|---|---|---|---|---|---|
| Cost item | Phase I NM | Phase II DVPM | Phase III VABFM | Phase I NM | Phase II DVPM | Phase III VABFM |
| Hospitalization | $ 87,275 | $ 82,000 | $ 20,400 | $21,820 | $16,000 | $ 3,600 |
| Missed treatments | 9,600 | 9,000 | 2,650 | 2,400 | 1,800 | 480 |
| Catheters | 10,650 | 6,750 | 2,700 | 4,090 | 1,500 | 0 |
| New access/revisions | 62,170 | 101,312 | 38,000 | 41,450 | 50,656 | 15,200 |
| Thrombectomy | 125,450 | 95,000 | 12,000 | 0 | 0 | 0 |
| Angioplasty | 13,100 | 51,000 | 82,800 | 0 | 9,000 | 21,600 |
| Adjusted yearly cost | $308,245 | $345,062 | $158,550 | $69,760 | $78,956 | $40,880 |

## Table III-3. Access Flow Protocol Surveillance

Access flow measured by ultrasound dilution, conductance dilution, thermal dilution, doppler or other technique should be performed monthly. The assessment of flow should be performed during the first 1.5 hours of the treatment to eliminate error caused by decreases in cardiac output related to ultrafiltration. The mean value of 3 separate determinations performed at a single treatment should be considered the access flow.
AV Graft and AV Fistula

Access Flow less than 600 mL/min, the patient should be referred for fistulogram.
Access Flow less than 1,000 mL/min that has decreased by more than 25% over 4 months should be referred for fistulogram.

# Practisch

- In triplo
- Maandelijks AVG’s en hoogrisico AVF’s
- AVF flow <600 ml/min
- AVG flow < 750 ml/min
- Daling van 25 %
- Tijdens ganse duur van dialyse op een hemodynamisch stabiel moment, steeds te controlleren bij start van volgende dialyse

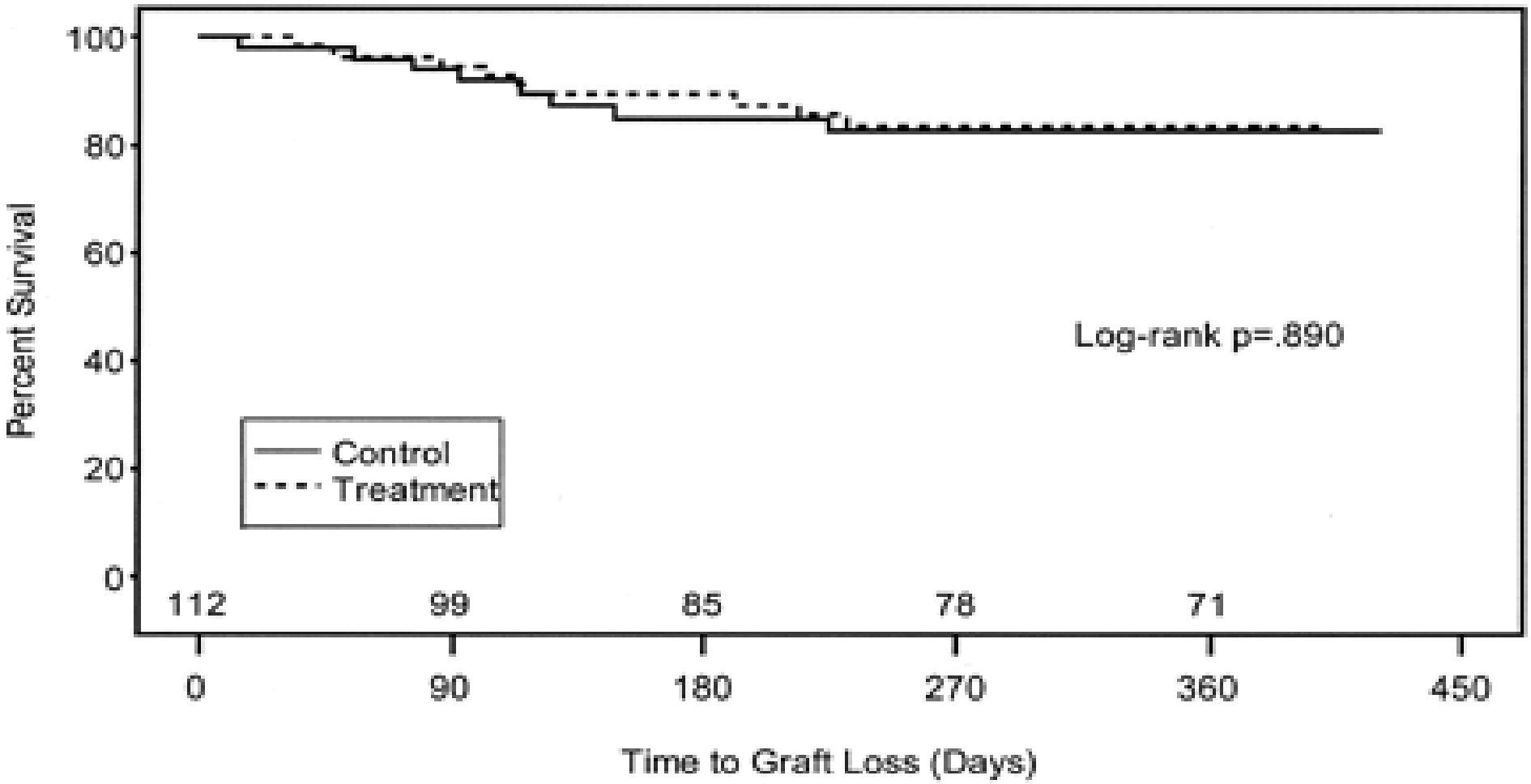



*Figure 3.* Time to graft loss comparing standard monitoring (control) to standard monitoring plus regular access flow (Qa) (treatment).

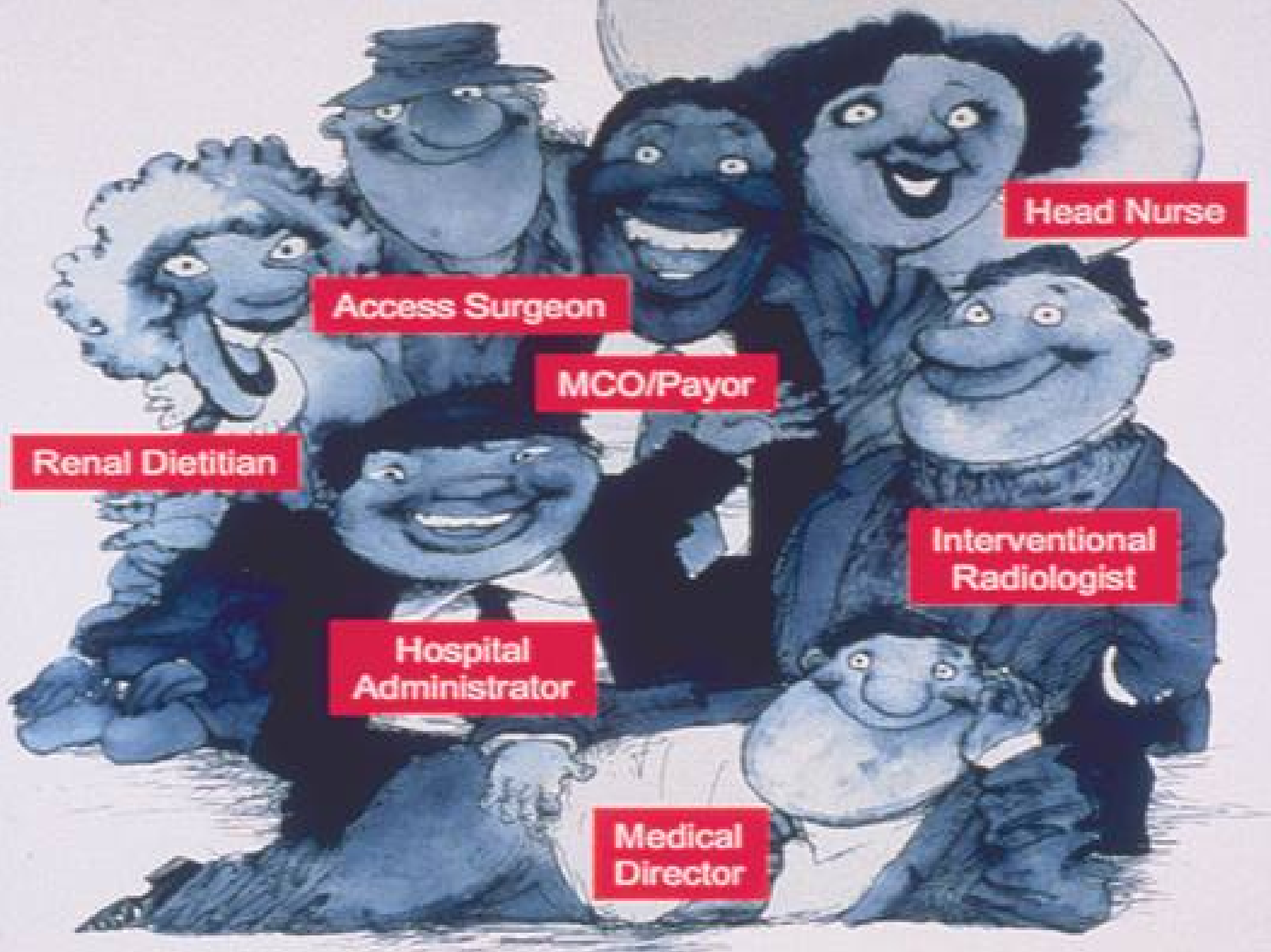
# Qa monitoring toch niet succesvol?

- Qa na PTA (succes PTA) bepaalt de verdere graft overleving
  - Slechts 40% na PTA flow meer dan 600 ml/min
  - 75% van grafts na PTA hebben nieuwe PTA nodig binnen de 6 maand
- PTA beschadigd endotheel met meer stenosis voor gevolg of balondilatatie niet succesvol

# Stents?

# Conclusie

- Maandelijks flow meting zowel in fistula als grafts
- Snelle verwijzing naar interventionele radioloog voor electieve/preventieve dilatatie
- Indien geen stijging Qa post dilatatie: stenting?


Head Nurse
Access Surgeon
MCO/Payor
Renal Dietitian
Interventional Radiologist
Hospital Administrator
Medical Director

# Creatie van meer natieve fistels

**GUIDELINE 3**

**Selection of Permanent Vascular Access and Order of Preference for Placement of AV Fistulae**

**A. The order of preference for placement of AV fistulae in patients with kidney failure who will become hemodialysis dependent is:**

1. **A wrist (radial-cephalic) primary AV fistula (Evidence)**
2. **An elbow (brachial-cephalic) primary AV fistula (Evidence/Opinion)**

**B. If it is not possible to establish either of these types of fistula, access may be established using:**

1. **An arteriovenous graft of synthetic material (eg, PTFE) (Evidence) or**
2. **A transposed brachial basilic vein fistula (Evidence)**

**C. Cuffed tunneled central venous catheters should be discouraged as permanent vascular access.**

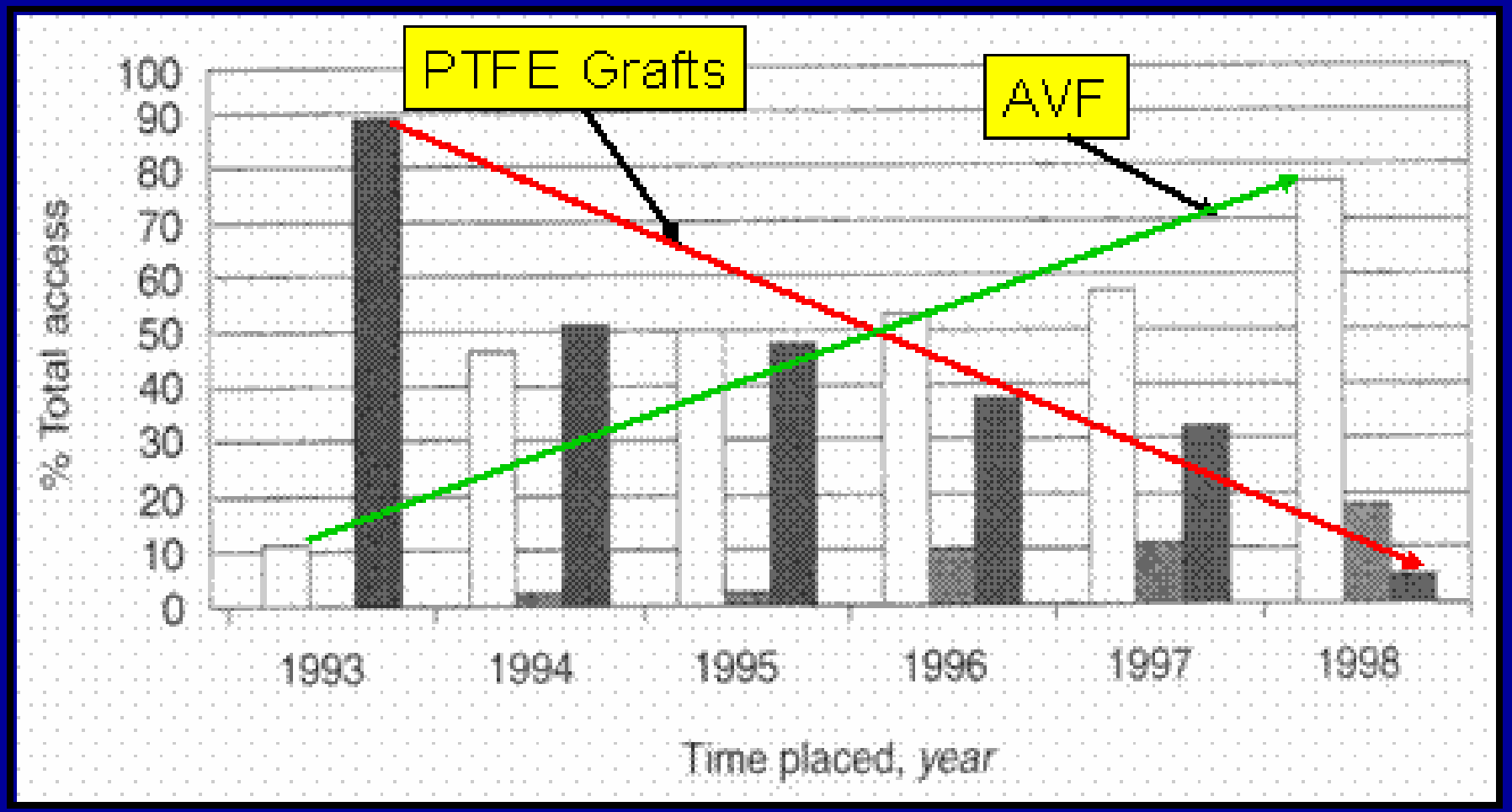
# Creatie van meer natieve fistels

A. **Primary AV fistulae should be constructed in at least 50% of all new kidney failure patients electing to receive hemodialysis as their initial form of renal replacement therapy. Ultimately, 40% of prevalent patients should have a native AV fistula (see Guideline 3: Selection of Permanent Vascular Access and Order of Preference for Placement of AV Fistulae.) (Opinion)**

**B. Patients should be re-evaluated for possible construction of a primary AV fistula after failure of every dialysis AV access. (Opinion)**

**C. Each center should establish a database to track the types of accesses created and the complication rates. (Opinion)**

# Successful AVF Creation




*Gibson et al: K I, Vol. 59 (2001), pp. 2335-2345*

# Creatie van meer natieve fistels

**Preservation of Veins for AV Access**

**A. Arm veins suitable for placement of vascular access should be preserved, regardless of arm dominance. Arm veins, particularly the cephalic veins of the nondominant arm, should not be used for venipuncture or intravenous catheters. The dorsum of the hand should be used for intravenous lines in patients with chronic kidney disease. When venipuncture of the arm veins is necessary, sites should be rotated. (Opinion)**

**B. Instruct hospital staff, patients with progressive kidney disease (creatinine >3 mg/dL), and all patients with conditions likely to lead to ESRD to protect the arms from venipuncture and intravenous catheters. A Medic Alert bracelet should be worn to inform hospital staff to avoid IV cannulation of essential veins. (Opinion)**

**C. Subclavian vein catheterization should be avoided for temporary access in all patients with kidney failure due to the risk of central venous stenosis. (Evidence)**