

***Vascular mapping***  
***an important tool to minimize***  
***catheter use***

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# Vascular Mapping

*An important tool to minimize catheter use*

**Both, the “Fistula First” and NKF-DOQI  
have emphasized the preoperative  
mapping increases the creation of an  
arteriovenous fistula and should be  
performed in patients with advanced  
chronic kidney disease approaching  
dialysis**

# Vascular Mapping:

**Both arterial and venous evaluation should be performed**

- **Arterial Evaluation**

- In simple terms, an artery should be able to provide adequate flow without putting the hand at risk for ischemia*

- **Venous Evaluation: The requirements include**

- Straight segment for cannulation (8-10 cm)*

- Superficial position (ease of cannulation)*

- Patent proximal and central veins*

# **Vascular Mapping Techniques**

- **Physical examination**
- **Ultrasound evaluation**
- **Angiography**

# Pre-Placement Evaluation

- **History**
  - **Prior access**
  - **Surgery, trauma**
  - **Pacemakers**
  - **Co-morbid conditions** (diabetes, peripheral vascular disease)
- **Inspection: Evidence of catheter scars/central venous stenosis**

# Physical Examination

## Arterial Evaluation

### Pulse examination

- Brachial, ulnar and radial palpation

### Differential blood pressure between arms

< 20 mm Hg difference

### Allen test

- Negative for both ulnar and radial artery occlusion

# Physical Examination:

**Seems to work for arterial evaluation**

- **A study of 86 patients**
- **Brachial, arterial and radial pulses were +2 to +3 on palpation**
- **Allen test was negative**
- **Blood pressure difference between the two arms did not exceed 20 mm/Hg**
- **68 AVF and 4 grafts were placed**
- **10 patients refused surgery and 4 had exhausted veins**

*Asif et al: Kidney Int 67:2399-2406, 2005*

# Physical Examination:

## Venous evaluation

- **Venous Evaluation:**
  - Tourniquet application and inspection of the extremity for:**
    - Diameter of the veins
    - Length to the cannulation segment
    - The examination must include inspection of the chest wall for evidence of central venous stenosis

# **Physical Examination**

## **(Advantages)**

- **Ease of performance**
- **Cost effective**
- **Time**

# Physical Examination

**Limitation: Not a good test to evaluate the veins**

- **In some patients veins are not apparent on physical examination. This examination can miss veins in such situations.**
- **Central stenosis can be missed by this test.**

# Physical Examination (Limitation)

- In a study of 116 patients
- Only 54 [46.5%] patients had suitable for fistula creation on physical examination
- And 62 [53.5%] patients did not show suitable veins for fistula creation on physical examination

*Malovrh M: Am J Kidney Dis 39:1218-1225, 2002*

# **Physical Examination (Limitation)**

- **These 62 patients then underwent ultrasound evaluation**
- **77% demonstrated adequate veins on duplex ultrasonography and were candidates for fistula creation.**
- **All received fistulae successfully.**

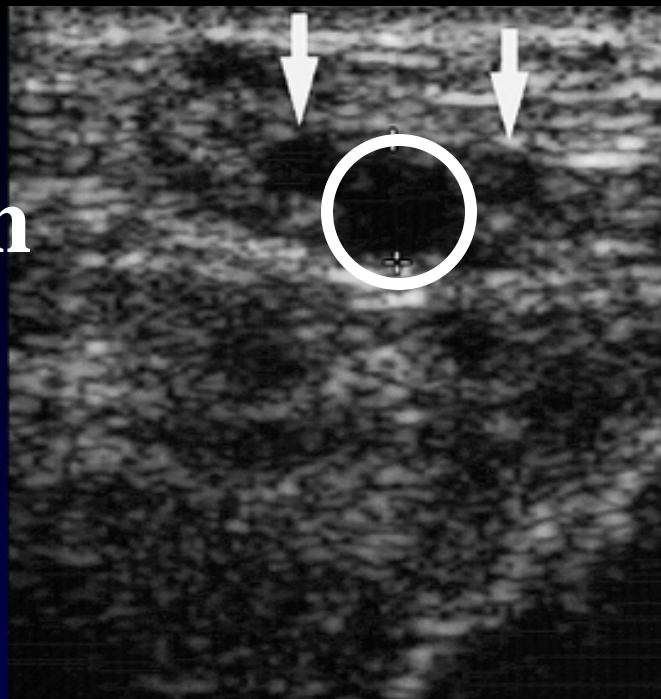
*Malovrh M: Am J Kidney Dis 39:1218-1225, 2002*

# **Ultrasound Examination**

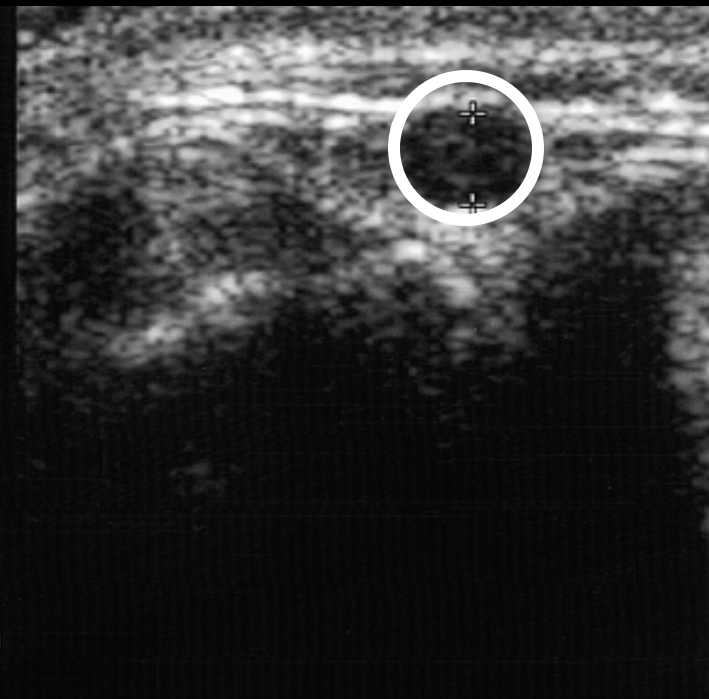
- **Objective assessment**
- **Allows for accurate assessment of venous and arterial diameter**
- **Depth of the vein from the surface of skin**
- **Important criteria (Luminal diameter venous: 2.5 mm; arterial 2.0 mm)**
- **Allows for functional parameters to be recorded (duplex examination of arteries)**
- **Calcified and atherosclerotic arteries can be detected by ultrasound examination**

Cephalic vein  
is being shown

*Image from  
Gerald Beathard*

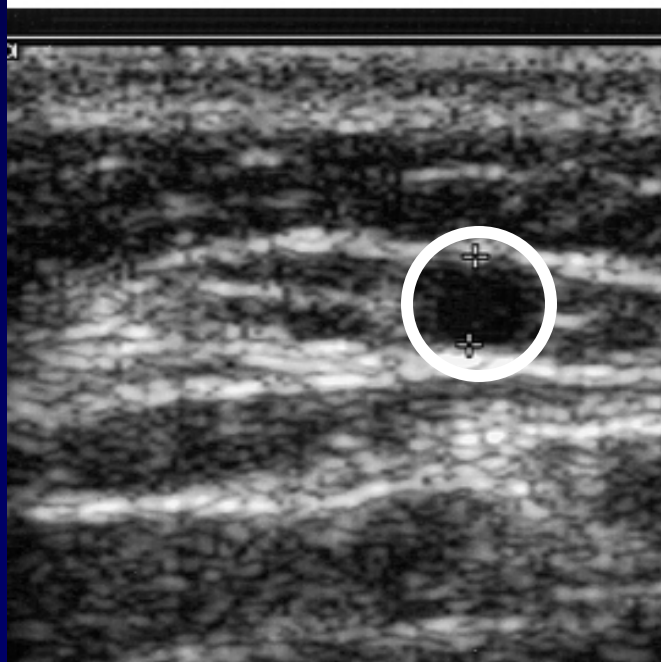


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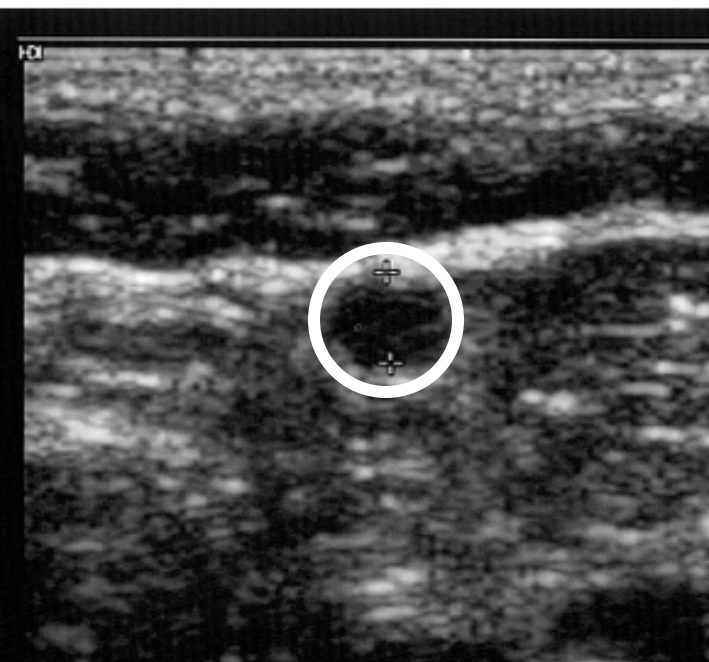


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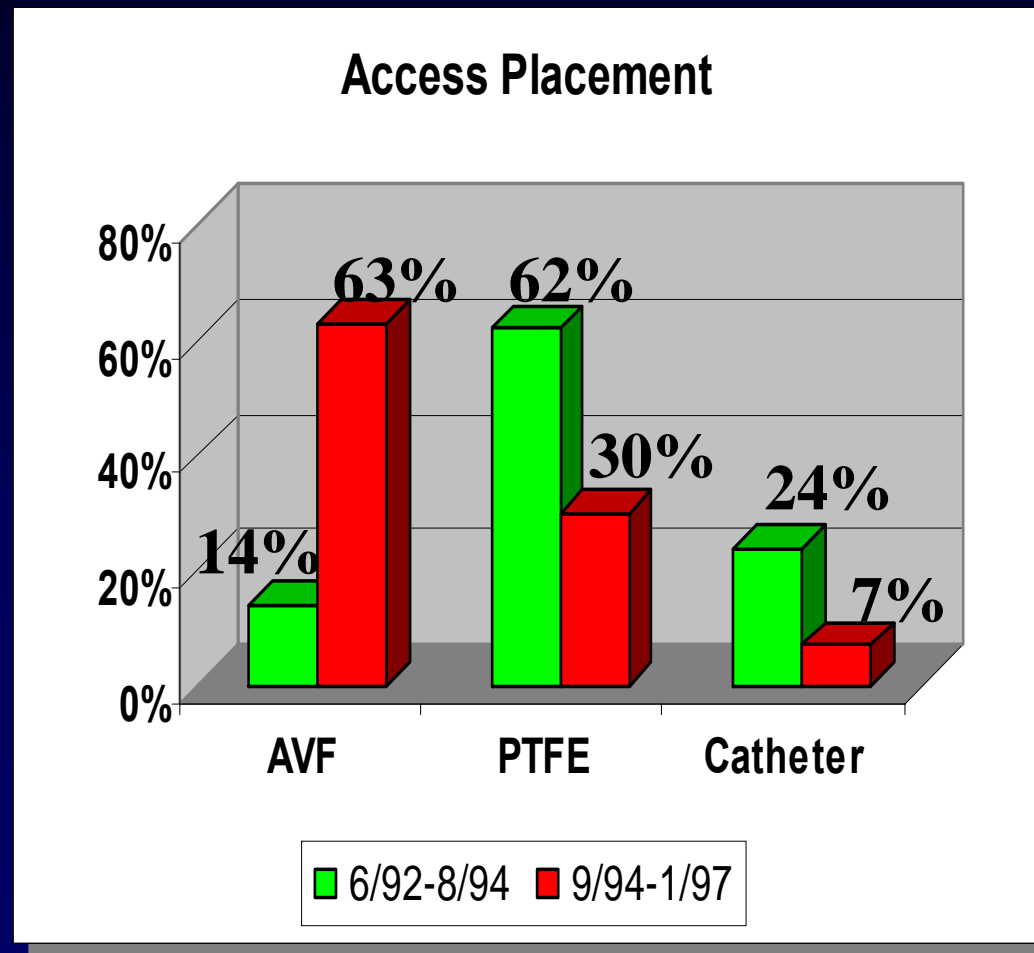
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**Silva's results are illustrated in this slide. Utilizing this ultrasound protocol, AV fistula creation increased from 14% to 63% when ultrasound mapping was employed as compared to physical examination and catheter use decreased from 24% to 7%.**



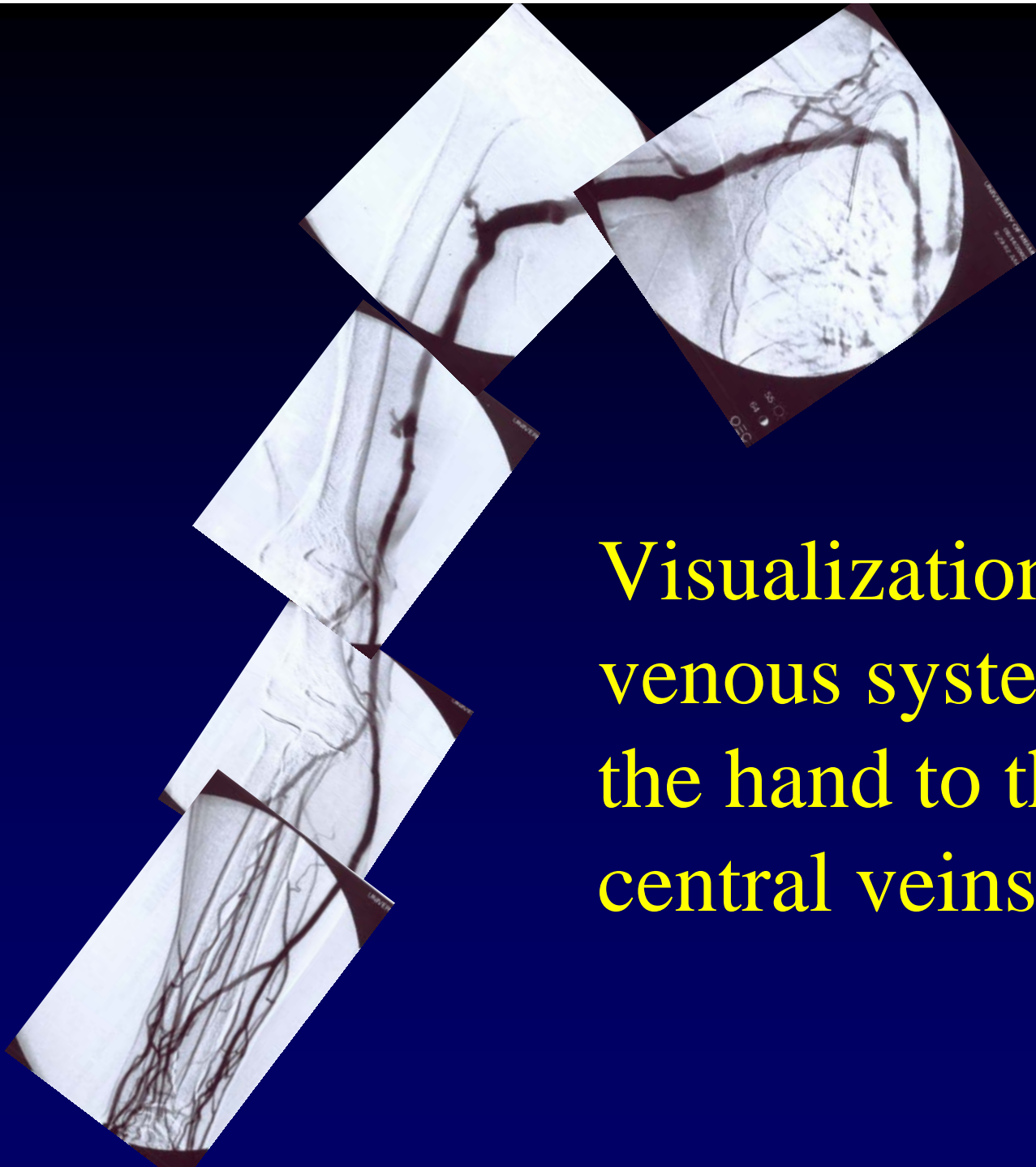
# **Ultrasound Examination (Limitation)**

- Does not allow for direct visualization of the central veins.**
- This point is important as many patients are dialyzing using a tunneled catheter and the risk of central venous stenosis is high in this population. It is then important to have the information regarding central venous stenosis before a fistula is created**

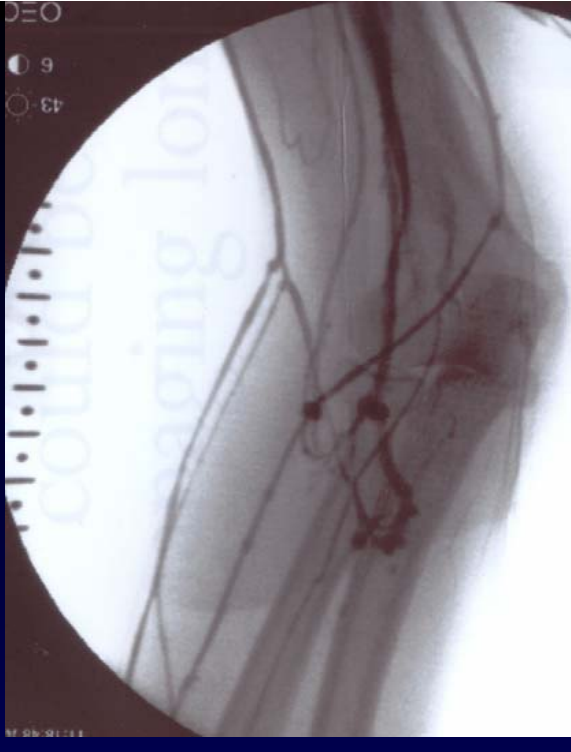
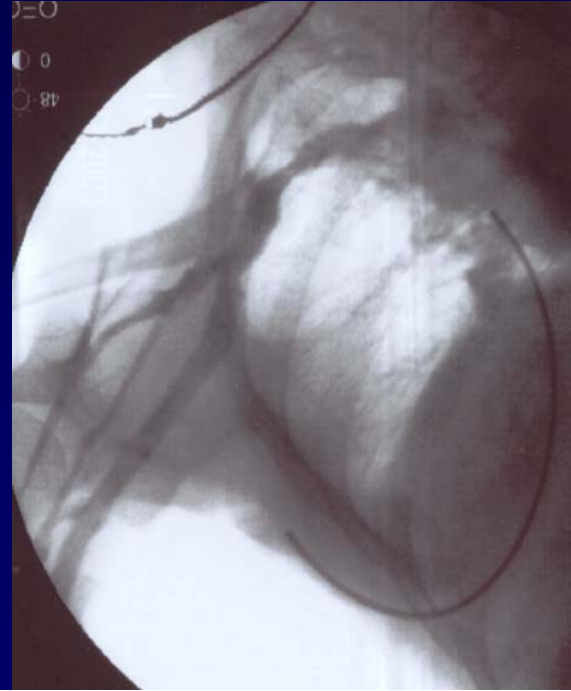
**Angiography is considered to be the gold standard by many investigators**

# Angiographic Evaluation

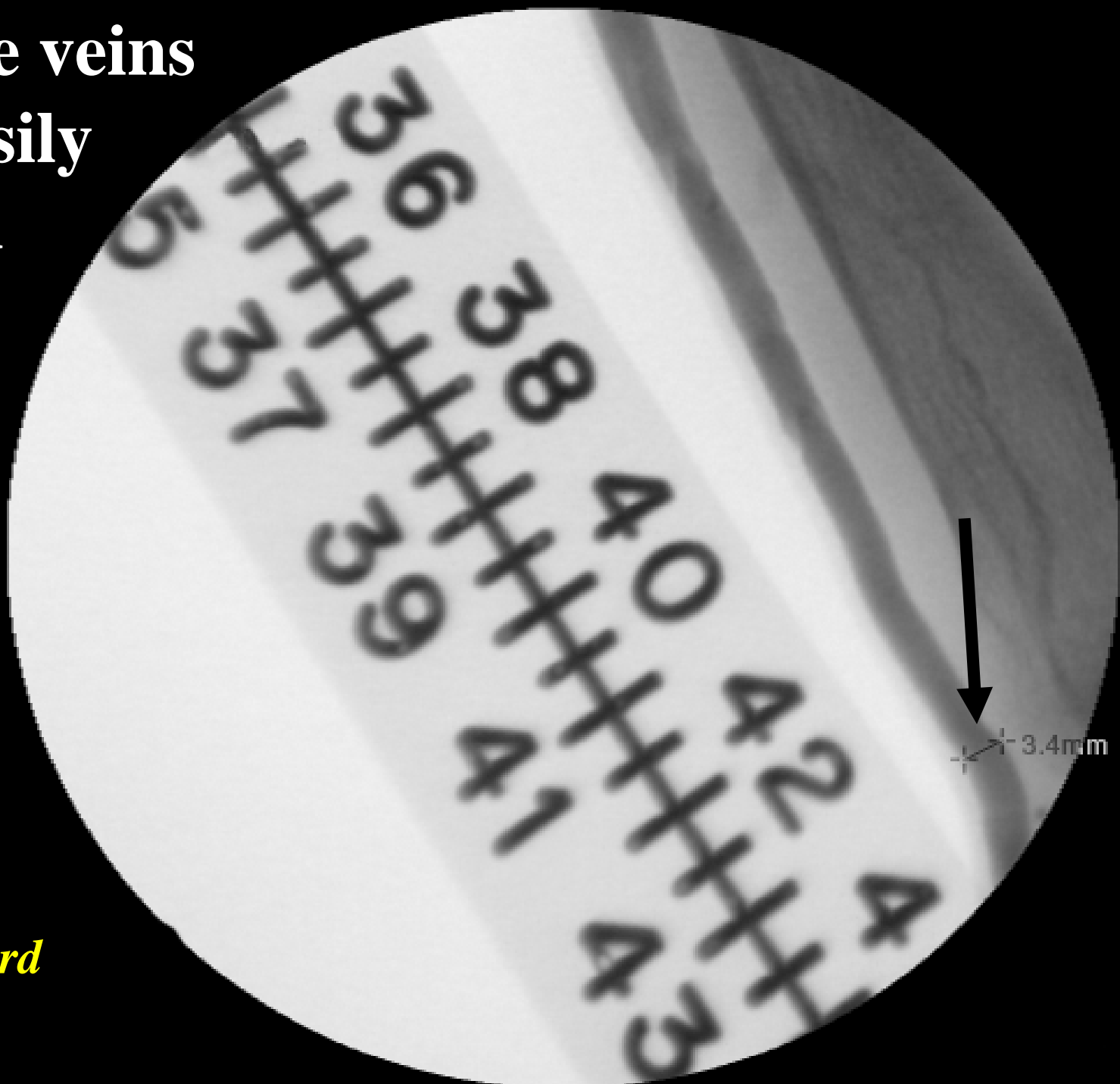
- **Both arteries and veins can be examined.**
- **Allows for accurate measurements.**
- **Vessels can be directly visualized including the central veins.**



Visualization of the  
venous system from  
the hand to the  
central veins



**Size of the veins  
can be easily  
measured**



*Image from  
Gerald Beathard*

# Angiographic Evaluation

- In a study, 86 patients underwent angiographic evaluation of the veins
- 82/86 had adequate veins for fistula creation.
- Only 4 cases did not have adequate veins
- 10 refused surgery
- 72 received an AV access (68 AVF; 4 AVG)

*Asif et al: Kidney Int 67:2399-2406, 2005*

# **Angiographic Evaluation (Limitations)**

- **Not a good test for arterial evaluation (invasive, lack of functional assessment)**
- **Does not determine the depth of the veins**
- **Has been highlighted to expose the patient to the risk of radiocontrast-induced nephropathy**

**Data on contrast nephropathy,  
however, have been derived from  
cardiac catheterization  
laboratories or radiology suits**

- Average contrast volume used in  
these situations exceeds 100 cc.**

**Recently, studies have been initiated to examine the risk of radiocontrast nephropathy in patients with advanced renal failure undergoing vascular mapping or fistula salvage using minimal amount of radiocontrast dye**

- **A prospective study of 25 patients undergoing mapping (1)**
- **A retrospective study of 65 patients undergoing fistula salvage (2)**
- **A retrospective study of 30 patients undergoing vascular mapping (3)**

*1- Asif et al: Seminars in Dialysis 18:239-242, 2005*

*2- Kian et al: Kidney International 69: 1444-1449, 2006*

*3- Samaha A: Semin Dial 19:200-203, 2006*

# **Risk of Radiocontrast Nephropathy**

## ***Venous Mapping***

- **A study of 25 patients**
- **Prospective analysis**
- **CKD IV-V (GFR=  $13 \pm 4$  ml/min/1.73 m<sup>2</sup>)**
- **Contrast volume 10-20 cc**

***Asif et al: Seminars in Dialysis 18:239-242, 2005***

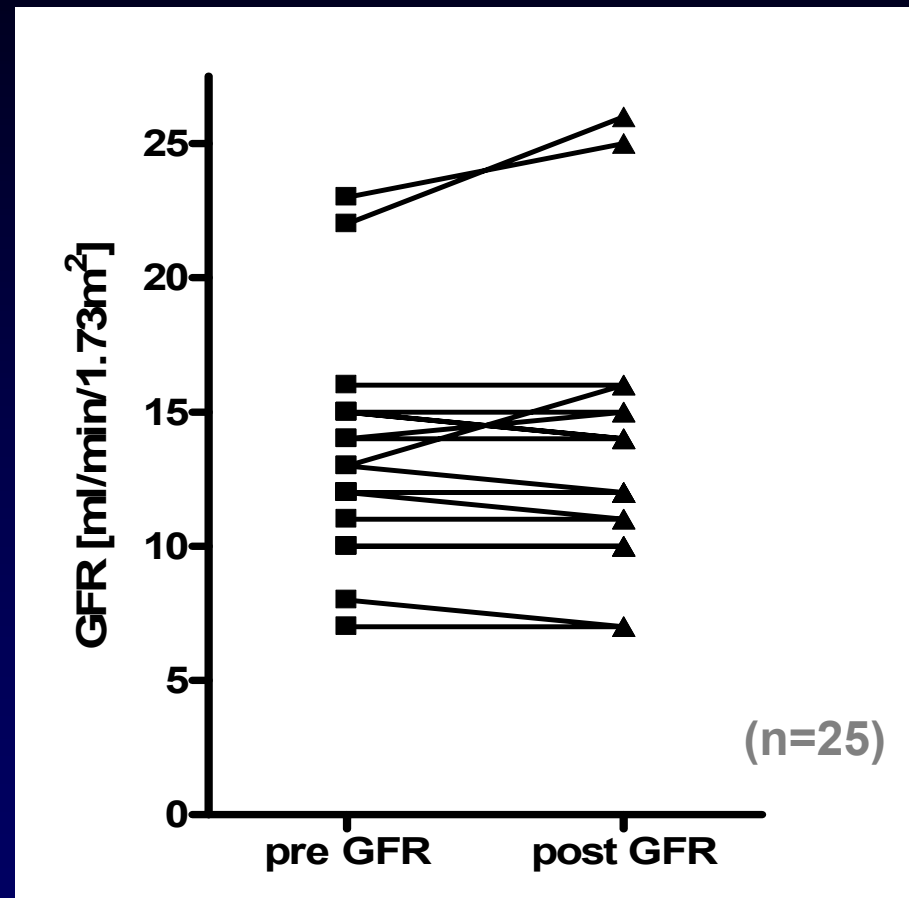
# Risk of radiocontrast nephropathy: *Demographic characteristics*

TABLE 1. Baseline characteristics of the patients

Number of patients	25
Age (years)	48.9 ± 7.8
Gender	
Men	56%
Baseline value	
GFR	13 ± 4 ml/min/1.73 m <sup>2</sup>
Race/ethnicity	
Hispanic	12 (48%)
African American	8 (32%)
Caucasian	2 (8%)
Haitian	3 (12%)
Cause of CKD	
Diabetic nephropathy	13 (52%)
Hypertension	9 (36%)
HIV-associated nephropathy	1 (4%)
Lupus nephritis	2 (8%)

*Asif et al: Seminars in Dialysis 18:239-242, 2005*

# No risk of contrast nephropathy at 48 hours



*Asif et al: Seminars in Dialysis 18:239-242, 2005*

# **Risk of Radiocontrast Nephropathy**

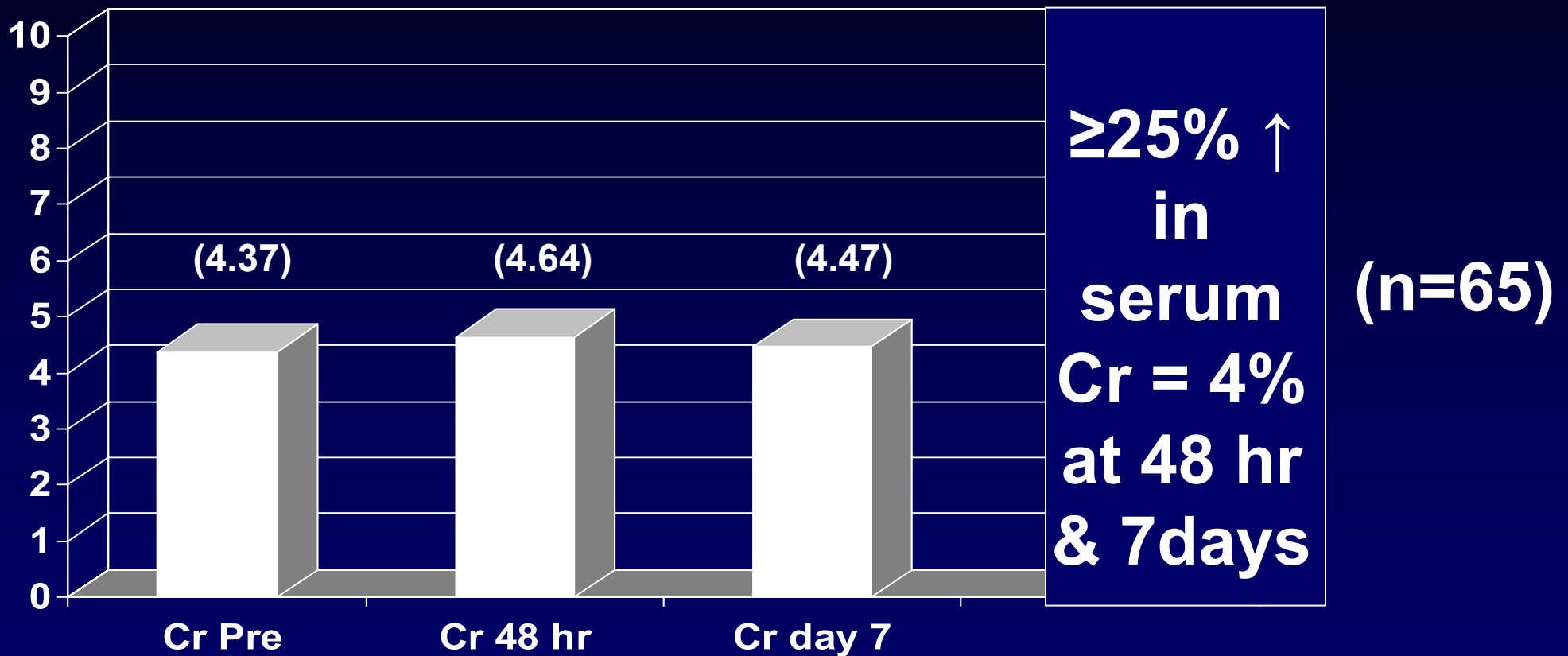
## *Salvage of Early Failure*

- **n=65**
- **Retrospective study**
- **Advanced renal disease (Cr=4.5 mg/dl)**
- **Mean dose of contrast dye= 7.8 cc**

*Kian et al: Kidney International 69: 1444-1449, 2006*

# Risk of Radiocontrast Nephropathy

## *Salvage of Early Failure*



*Kian et al: Kidney International 69: 1444-1449, 2006*

# Venography and the Risk of Radiocontrast Nephropathy

- **n=30**
- **Retrospective analysis**
- **Serum creatinine exceeding 4.8 mg/dl**
- **Contrast volume less than 10 cc**
- **No change at 48 hours and 7 days**

*Samaha A: Semin Dial 19:200-203, 2006*

# Summary

- **Vascular mapping increases the number of AVF**
- **Physical examination is not a good test to perform venous evaluation**
- **Both ultrasound and venography are good mapping techniques**
- **Renal team must take the lead in obtaining vascular mapping**