



ปวงข้าพระพุทธเจ้า ขอน้อมเกล้าน้อมกระหม่อม
รำลึกในพระมหากรุณาธิคุณหาที่สุดมิได้

PREEMPTIVE ULTRASOUND FOR A-V ACCESS

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ULTRASOUND VASCULAR MAPPING FOR PREOPERATIVE PLANNING OF DIALYSIS ACCESS

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K/DOQI Guidelines

Vascular access in hemodialysis patients

- 1) The nondominant arm AVF
: Dominant forearm (surgical preference)
- 2) Cephalic vein AVF : Forearm > Upper arm
- 3) Basilic vein transposition AVF, or other AVF configuration
- 4) AVG : forearm loop > upper arm straight > upper arm loop
- 5) Thigh AVG
- 6) Catheter based hemodialysis

Mandate vascular mapping in all patients approaching chronic dialysis

1) Physical examination

2) Duplex ultrasonography (DUS)

3) Venography

1. Clinical practice guidelines for vascular access. Am J Kidney Dis. 2006;48 Suppl 1:S176-247
2. Fistula First : the National Vascular Access Improvement Initiative. WMJ 2006 May; 105(3): 71-3.

IDEAL



REAL LIFE



VASCULAR MAPPING

1) Physical examination (PE.)

- An adequate vein : only 47% CKD patients
- Poor clinically visible or clinically absent veins : 54%

2) Duplex ultrasonography (DUS)

- Poor clinically visible or clinically absent veins
>> 75% : showed adequate veins

3) Venography

- Complex vascular access , multiple prior access procedures

PE. CAN BE LIMITED

- **Obese patients**
- **Multiple previous access surgeries**

Obese patients + Multiple previous access surgeries



PREOPERATIVE DUS MAPPING

- Mapping of arm vessels before surgical creation of dialysis access
 - Higher percentage of AVF placements as well as an increased fistula success rate
 - Reduction in use of tunneled HD catheters

1. Allon M, et al. Kidney Int 2001; 60:2013–2020.

2. Allon M, Robbin ML. Kidney Int 2002; 62:1109–1124.

3. Robbin ML, et al. Radiology 2000; 217:83–88.

4. Silva MB Jr, et al. J Vasc Surg 1998; 27:302–308.

5. Wong CS, et al. J Vasc Surg. 2013;57(4):1129–1133.

6. Ferring M, et al. Clin J Am Soc Nephrol. 2010;5(12):2236–2244.

7. Asif A, et al. Kidney Int 67:2399–2406, 2005.

**ROUTINE
PREOPERATIVE DUS**

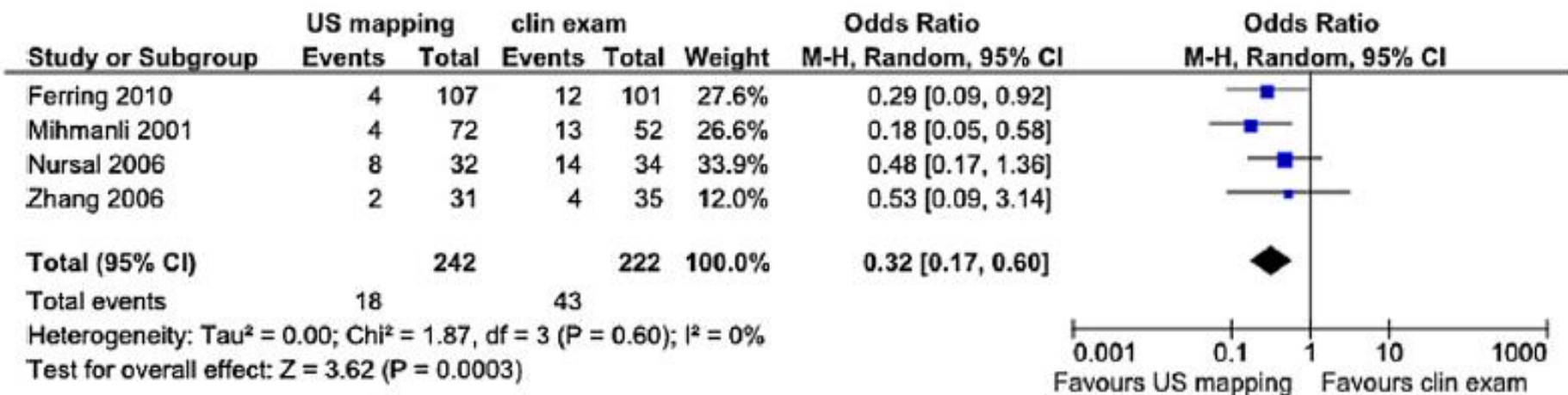
VS

PE. or Selective DUS ?

Routine Pre-operative Ultrasound Mapping Before AVF Creation :A Meta-analysis

(Based mainly on moderate quality RCTs)

THE IMMEDIATE FAILURE RATE DUS VS Clinical exam or Selective US



Odds ratio (OR) 0.32

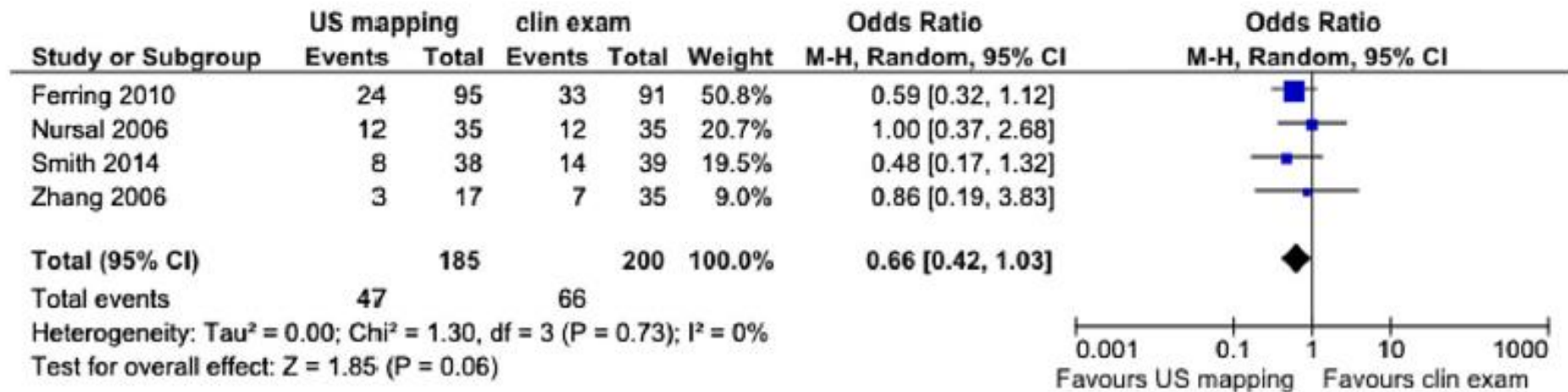
95% CI 0.17-0.60

$p < .01$

THE EARLY/MIDTERM ADEQUACY FOR HEMODIALYSIS

(usability for HD, at 1 or 6 mo. post-op)

Routine DUS VS Clinical exam or Selective US



Odds ratio (OR) 0.66
 95% CI 0.42-1.03
 $p = 0.06$

THE EARLY/MIDTERM ADEQUACY FOR HEMODIALYSIS

(usability for HD, at 1 or 6 mo. post-op)

Routine DUS VS Selective DUS

routine US

selective US

Odds Ratio

Odds Ratio

CONCLUSION :

The clinical examination should always be supplemented with routine DUS mapping before AVF creation

Heterogeneity: $\text{Tau}^2 = 0.00$; $\text{Chi}^2 = 0.13$, $\text{df} = 1$ ($P = 0.72$); $I^2 = 0\%$

Test for overall effect: $Z = 2.13$ ($P = 0.03$)

0.001

0.1

1

10

1000

Favours Routine US

Favours Selective US

Odds ratio (OR) 0.56

95% CI 0.33-0.95

$p = 0.03$

Routine preoperative DUS improves patency and use of AVFs :A Randomized Trial

	Clinical assessment group	Ultrasound group	P - value
Rate of immediate failure	11%	4%	0.028
Failed AVFs, thrombosis	67%	38%	0.029
Primary AVF survival 1 year	56%	65%	0.081
Assisted primary AVF survival 1 year	65%	80%	0.012

Duplex Ultrasound (DUS)

- B-mode imaging :
Gray scale
- Color-flow Doppler
- Spectral Doppler
waveforms



GE HEALTH CARE ; VIVID7

Duplex Ultrasonography (DUS)

Linear array transducer

- Higher –frequency
- 12-18 MHz
- Better sensitivity to low flow
- More superficial vein



Curved linear or Phased array transducer

- Lower -frequency
- 2.5 -3.5 MHz
- Better penetration
- Central veins : innominate vein or SVC



SUCCESSFUL VASCULAR ACCESS CREATION

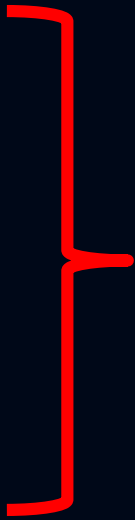
1) OPTIMAL INFLOW

:Arterial Examination

2) OPTIMAL OUTFLOW

:Venous Examination

3) OPTIMAL CONDUIT & GOOD ANASTOMOSIS



DUS

OPTIMAL INFLOW

ARTERIAL EXAMINATION

- Brachial artery pressures both arms for comparison
- Pulse examination
 - Axillary ,Brachial ,Radial ,Ulnar arteries
- Modified Allen's test

DUS

ARTERIAL EXAMINATION

- Sufficient size (variable & series dependent)
: diameter ≥ 0.20 cm

Silva MB Jr, et al. J Vasc Surg 1998; 27:302–308.

Parmar J, et al. Eur J Vasc Endovasc Surg 33:113–115, 2007.

Sidawy AN, et al. J Vasc Surg. 2008;48(5 Suppl):2S-25S.

Nakata et al. SpringerPlus 2016;5:462

- The internal luminal diameter of the artery

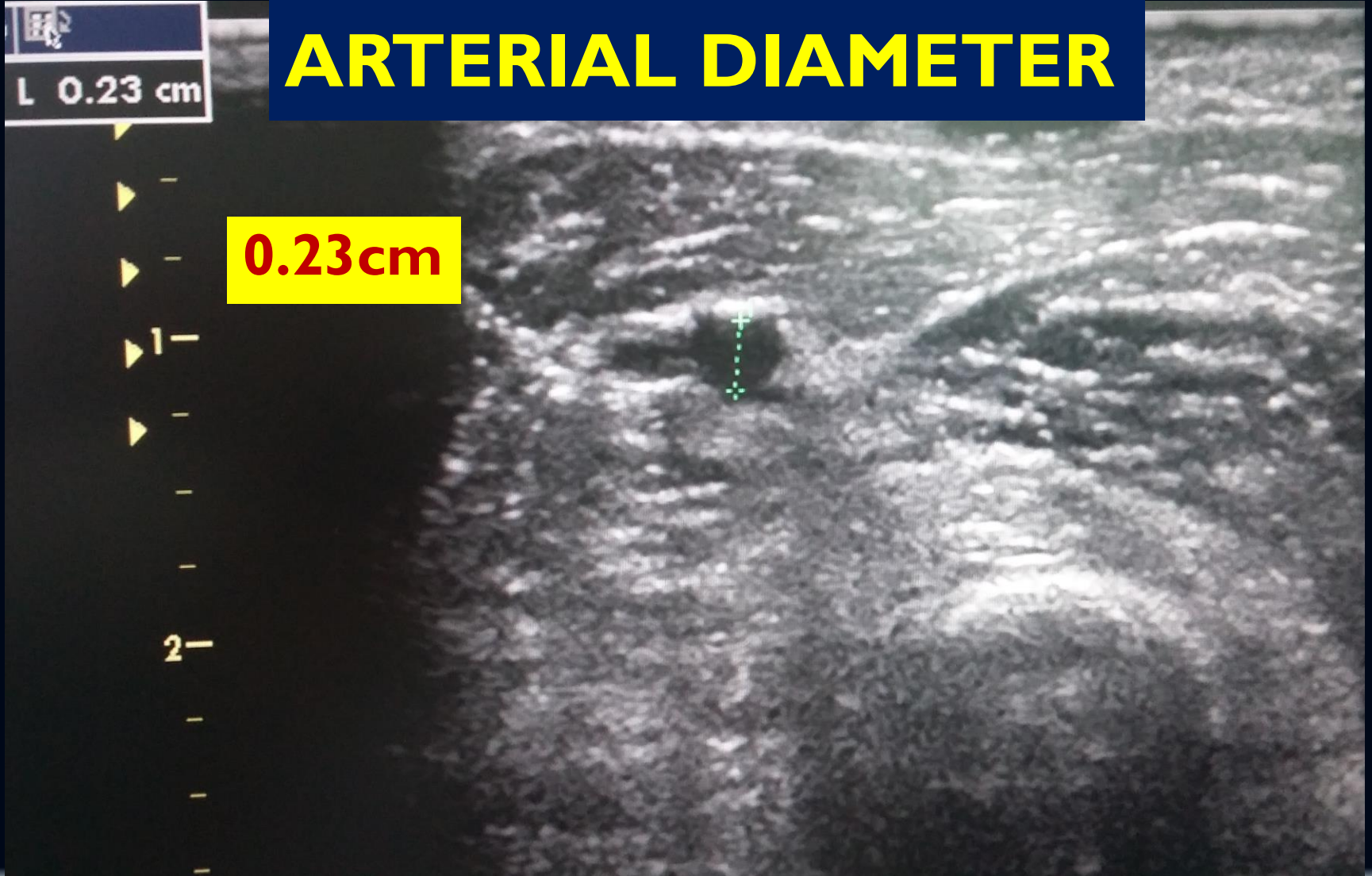
DUS

ARTERIAL EXAMINATION

ARTERIAL DIAMETER

L 0.23 cm

0.23cm



DUS

ARTERIAL EXAMINATION

- Sufficient size (variable & series dependent)
: diameter ≥ 0.20 cm

Silva MB Jr, et al. J Vasc Surg 1998; 27:302–308.

Parmar J, et al. Eur J Vasc Endovasc Surg 33:113–115, 2007.

Sidawy AN, et al. J Vasc Surg. 2008;48(5 Suppl):2S-25S.

Nakata et al. SpringerPlus 2016;5:462

- The internal luminal diameter of the artery
- Presence of significant concentric calcification ?

Concentric calcification : Radial artery



DUS

ARTERIAL EXAMINATION

- Sufficient size (variable & series dependent)
: diameter $\geq$ **0.20 cm**

Silva MB Jr, et al. J Vasc Surg 1998; 27:302–308.

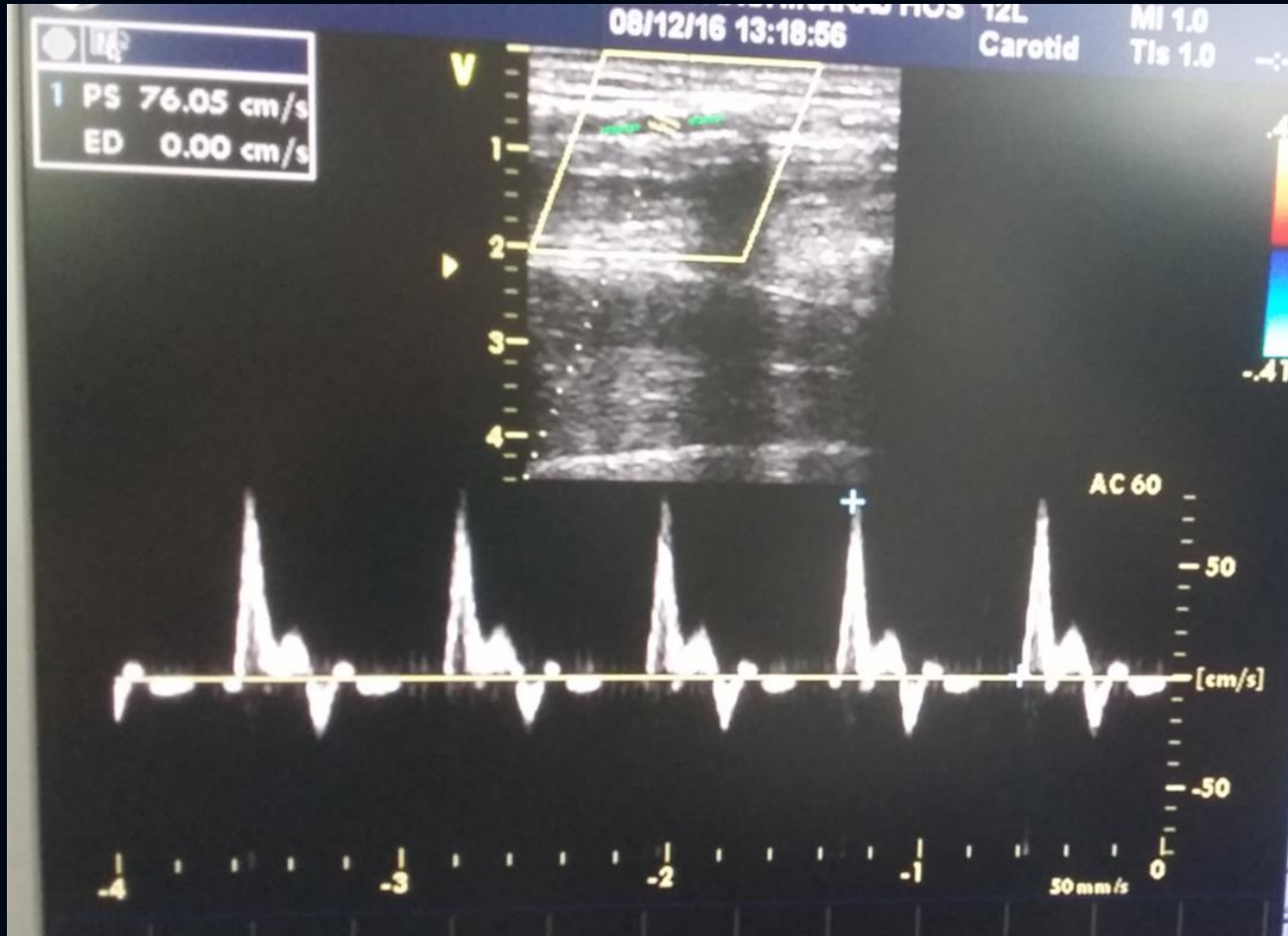
Parmar J, et al. Eur J Vasc Endovasc Surg 33:113–115, 2007.

Sidawy AN, et al. J Vasc Surg. 2008;48(5 Suppl):2S-25S.

Nakata et al. SpringerPlus 2016;5:462

- The internal luminal diameter of the artery
- Presence of significant concentric calcification ?
- Arterial spectral waveforms
: screen for Inflow or Outflow disease ?

Triphasic waveform & No significant focal velocity increases



Detecting
stenoses :

sensitivity
70 - 90.9 %

specificity
98.7 - 100%

DUS

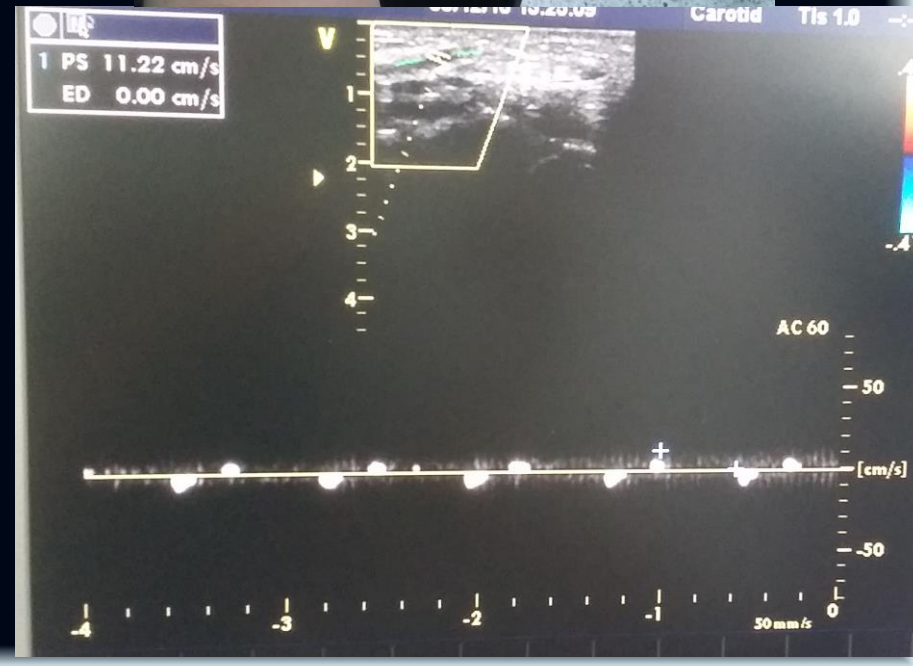
ARTERIAL EXAMINATION

For a forearm AVF

- Radial artery at the wrist
- Ulnar artery may be assessed
- A modified duplex Allen test

A MODIFIED DUPLEX ALLEN TEST

- Patency of the deep palmar arch
- Radial artery at the wrist and/or at the dorsum of the hand
- Reversal of blood flow distal to the proximal occlusion



DUS

ARTERIAL EXAMINATION

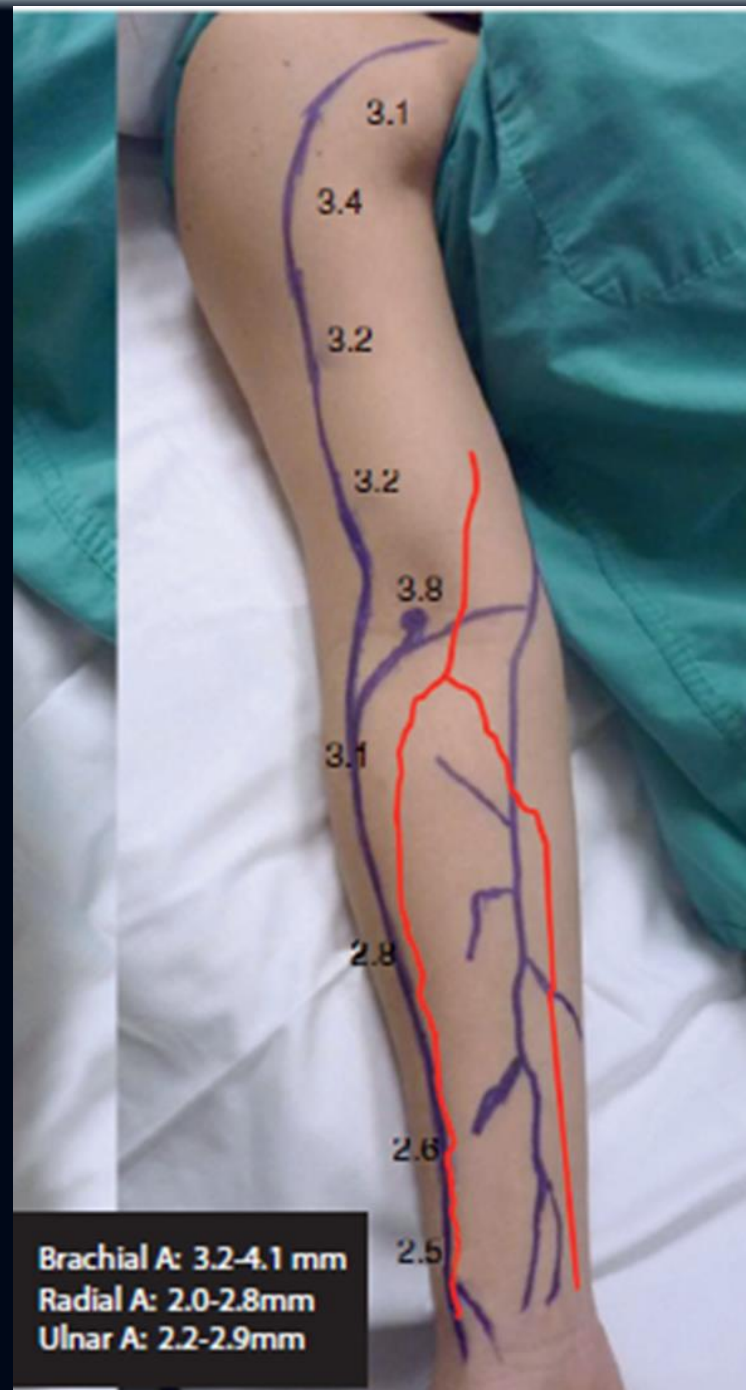
For a forearm AVF

- Radial artery at the wrist
- Ulnar artery may be assessed
- A modified duplex Allen test

For either AVF or graft creation

- Brachial artery at the antecubital fossa
- Brachial artery upper arm & Axillary artery
- **High brachial artery bifurcation ? (10%)**

- Brachial artery
- Radial artery
- Ulnar artery



OPTIMAL OUTFLOW

VENOUS EXAMINATION

- Adequate size , length , depth
- No outflow stenosis
 - : Forearm veins >> SVC

DUS

VENOUS EXAMINATION

- All veins should be measured after it is dilated
- Warm room
- Sequential tourniquet placement or an inflated BP cuff (60mmHg) – 2 to 3 min.



DUS

VENOUS EXAMINATION

- Diameter (ID) : variable & series dependent
 - : ≥ 0.25 cm for an AVF
 - : ≥ 0.4 cm for an AVG or Basilic upper arm transposition

Silva MB Jr, et al. J Vasc Surg 1998; 27:302–308.

Malovrh M, Am J Kidney Dis 39:1218–1225, 2002.

Sidawy AN, et al. J Vasc Surg. 2008;48(5 Suppl):2S-25S.

Zierler RE: Strandness's duplex scanning in vascular disorders, ed 4, 2010.

Arroyo MR, et al. J Vasc Surg 2008; 47:1279-1283.

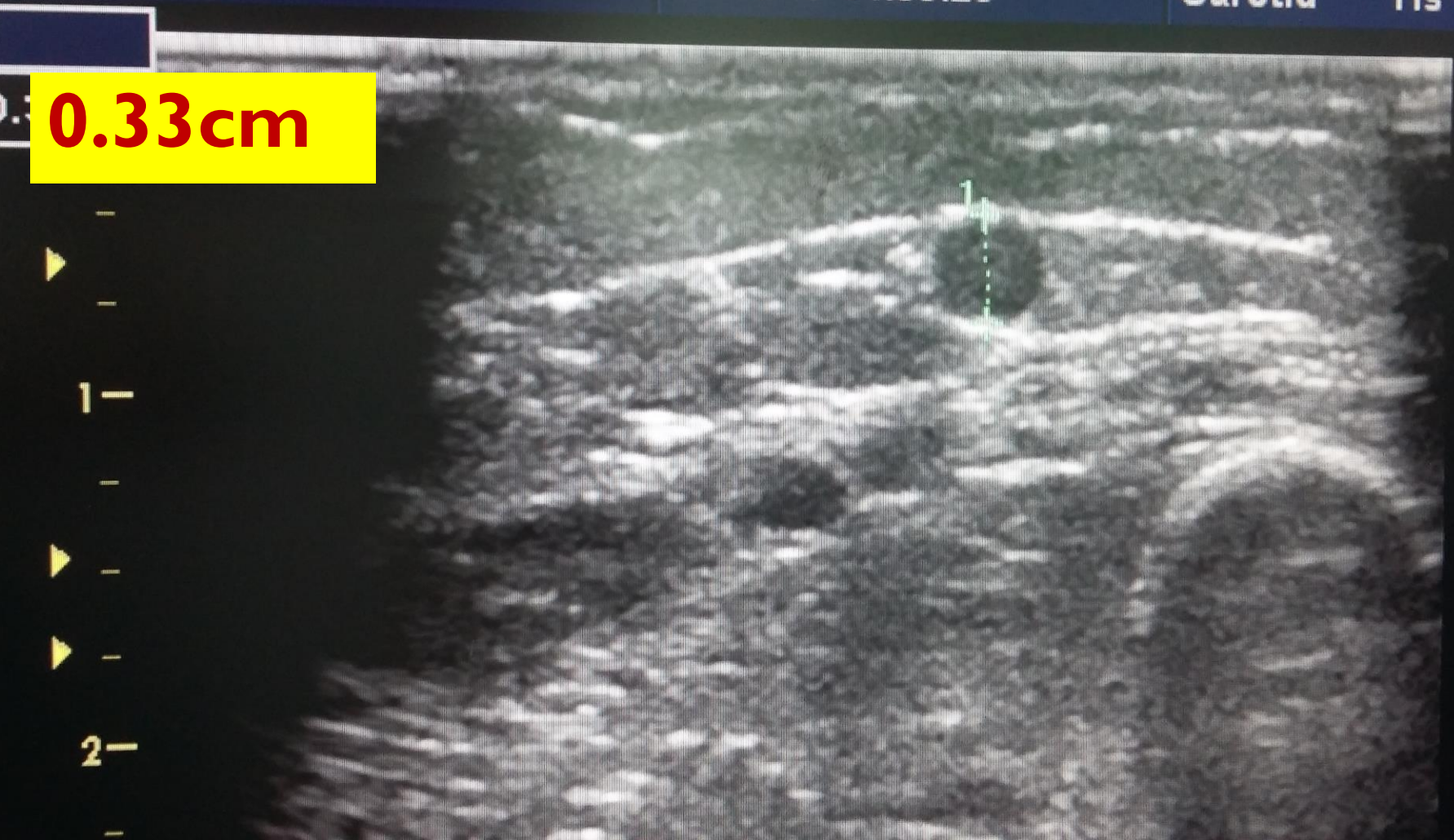
DIAMETER (ID)

BUDDHACHINARAJ HOS
17/11/16 14:03:26

12L
Carotid

MI 1.2
TIs 1.0

0.33cm



DUS

VENOUS EXAMINATION

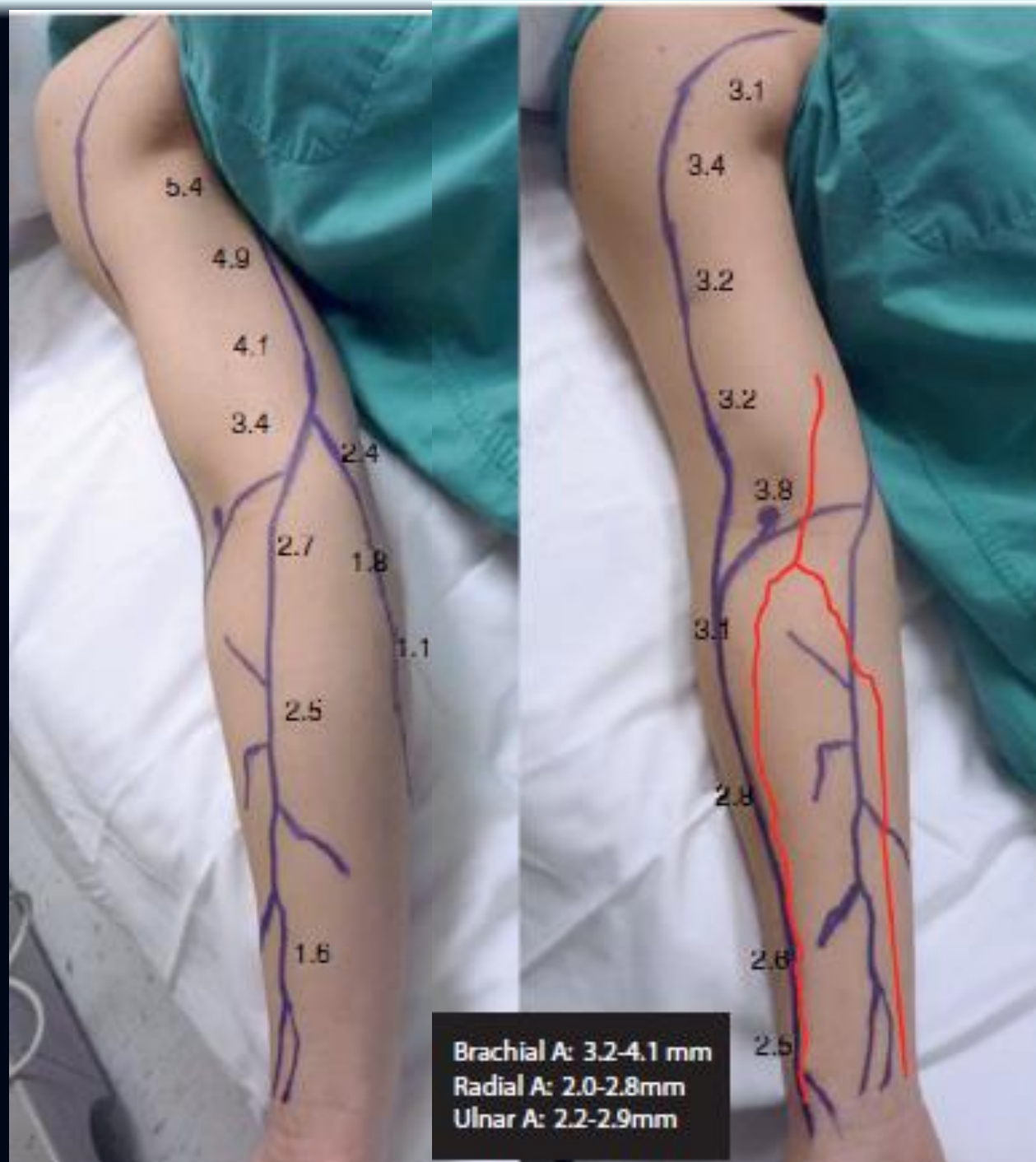
- Daily variation : alteration in vascular tone
 - Hydration related to dialysis cycle

Planken RN, et al: Nephrol Dial Transplant 21:802–806, 2006.

- More focused percussion or after application of a warm-water immersion (43-44°C)
 - : Borderline in size (0.05cm)

Lockhart ME, et al. J Ultrasound Med 2006; 25:1541–1545.
van Bemmelen PS, et al. J Vasc Surg 42:957–962, 2005.

- **Cephalic vein**
- **Basilic vein**
- **Median cubital Vein**
- **Brachial vein**
- **Axillary vein**



DUS

VENOUS EXAMINATION

1. Diameter measurement
2. Depth of vein from the skin surface ($< 0.5\text{mm}$)

DEPTH OF VEIN

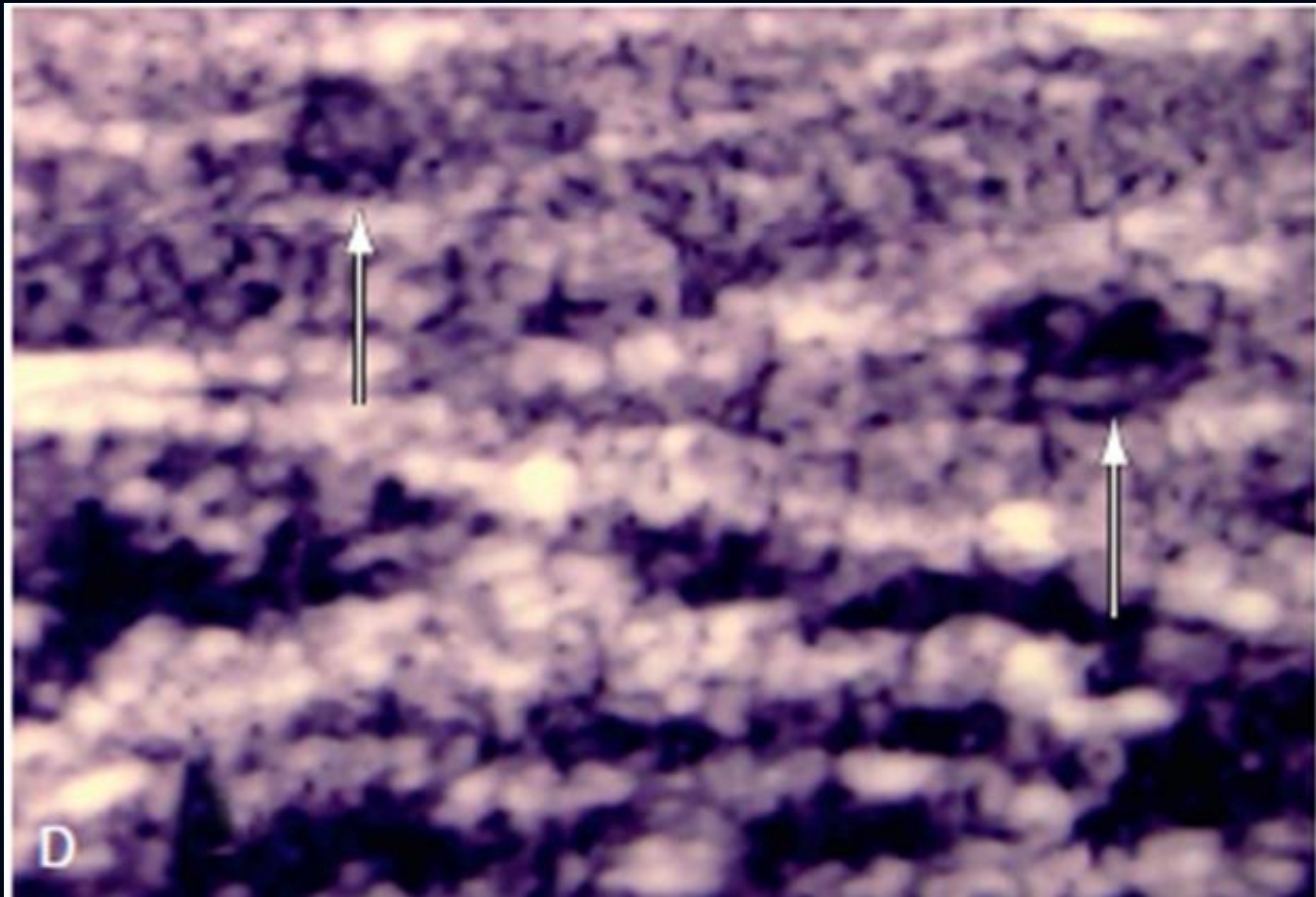


DUS

VENOUS EXAMINATION

1. Diameter measurement
2. Depth of vein from the skin surface ($< 0.5\text{mm}$)
3. Contiguous length of nondiseased vein (8-10 cm)
4. Compressibility : thrombus

Chronic thrombosis of the cephalic vein

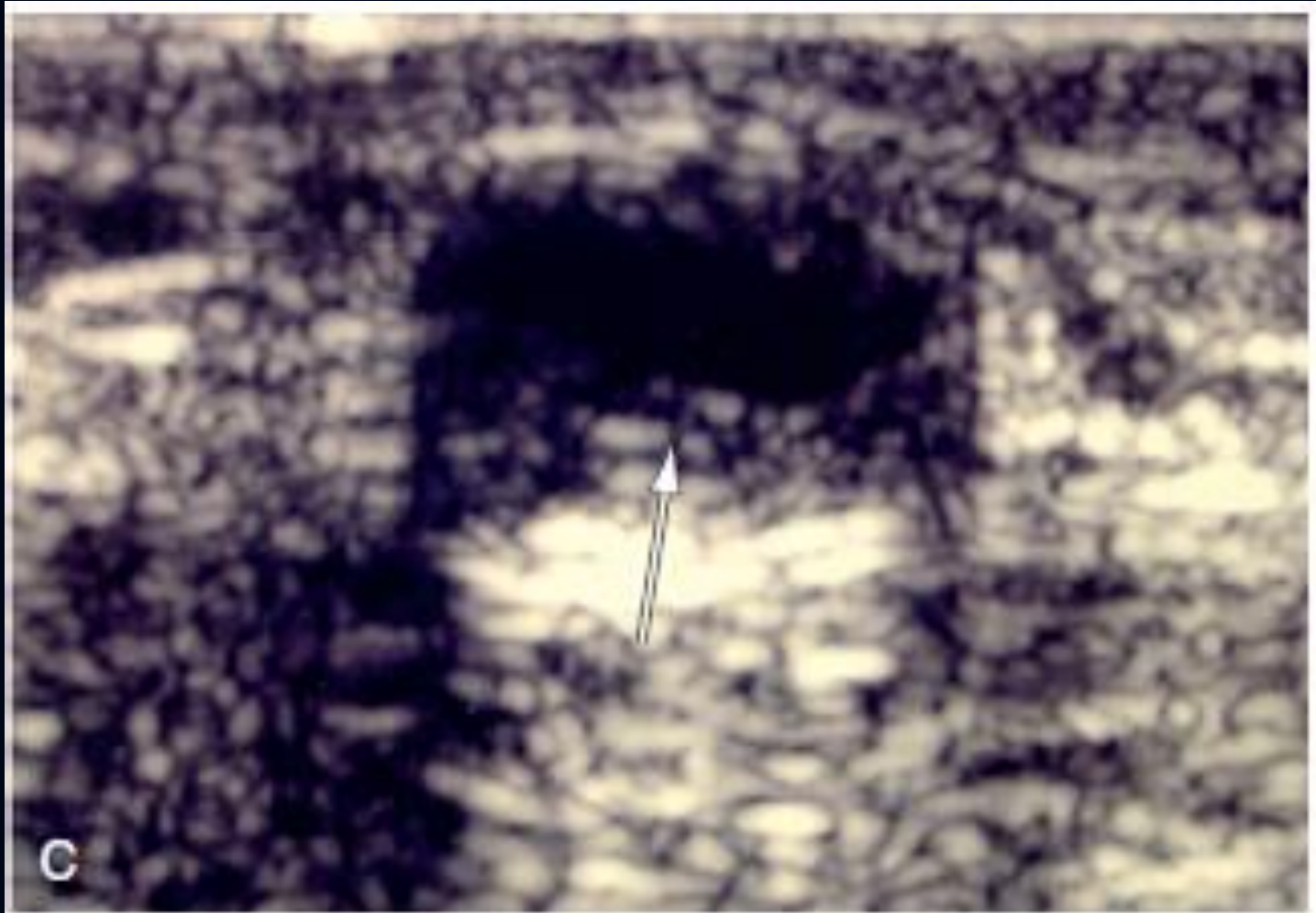


DUS

VENOUS EXAMINATION

1. Diameter measurement
2. Depth of vein from the skin surface ($< 0.5\text{mm}$)
3. Contiguous length of nondiseased vein (8-10 cm)
4. Compressibility : thrombus
5. Sclerotic or thick-walled vein

Vein wall thickening from needle injury



DUS

VENOUS EXAMINATION

1. Diameter measurement
2. Depth of vein from the skin surface ($< 0.5\text{mm}$)
3. Contiguous length of nondiseased vein (8-10 cm)
4. Compressibility : thrombus
5. Sclerotic or thick-walled vein
6. Adequate venous drainage
7. Large branches of veins near the site of a fistula

Beathard GA, et al. Kidney Int 2003; 64:1487–1494.

Singh P, et al. Radiology 2008; 246:299–305.

Wiese P, et al. Nephrol Dial Transplant 19:1956–1963, 2004.

CENTRAL VENOUS STENOSIS

Should be suspected if

- 1) Any prominent venous collaterals or edema
 - 2) A differential in extremity diameter
 - 3) Any history of previous central venous catheter placement
 - 4) Multiple previous access sites
- Should be examined with deep venous duplex ultrasound imaging, followed by venography if necessary

DUS

CENTRAL VENOUS EXAMINATION

- Internal jugular vein ,distal innominate vein, subclavian vein and axillary vein : **Bilaterally**
- Respiratory phasicity : **Symmetric or Asymmetric**
- Transmitted cardiac pulsatility : **Absent or reduced**
- Unilateral or bilateral monophasic waveforms or Low-velocity venous waveforms
: **SVC or innominate vein stenosis?**

DUS ACCURACY

- Detection of venous stenosis, thrombosis, and occlusion
: Sensitivity 81%, Specificity 90%
- Sensitivities decrease for more proximal veins

TAKE HOME MESSAGE

- Routine preoperative DUS mapping :
 - ↓ AVF failure rate, ↑ Early/midterm adequacy
 - ↑ Assisted primary patency(1yr)
- Optimal inflow & outflow ↔ DUS
- Sufficient diameter :
 - Artery 0.2cm & Vein 0.25cm / 0.4cm



THANK YOU



ฉันเกิดในรัชกาลที่

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