MASSACHUSETTS GENERAL HOSPITAL
FIREMAN VASCULAR CENTER

DIALYSIS ACCESS SURVEILLANCE AND CASES

Luis B. Suarez, MD, FACS, RPVI

Medical Director Vascular Diagnostic Laboratory
Division of Vascular and Endovascular Surgery,
Massachusetts General Hospital
Member of the Faculty of Surgery, Harvard Medical School

HARVARD MEDICAL SCHOOL

NO DISCLOSURES

HEMODIALYSIS

- RENAL REPLACEMENT THERAPY
- END STAGE RENAL DISEASE.
- GFR <30 (MOSTLY STAT AROUND 10)
- ALB/CREAT RATIO >300
- RAPID PROGRESSION OF RENAL FAILURE
- SYMPTOMS (HYPERKALEMIA, UREMIA, VOLUME OVERLOAD)

ROSANSKY ET AL. BMC NEPHROL. 2017; 18: 200

ACCESS OPTIONS

- TUNNELED CATHETER (TLC)
- ARTERIO VENOUS FISTULA (AVF)
- ARTERIO VENOUS GRAFT (AVG)
- PERITONEAL DIALYSIS (PD)

FISTULA FIRST INITIATIVE

- CENTER FOR MEDICARE SERVICE INITIATIVE
- GOALS:
  - 1. PRIMARY AVF PLACEMENT IN AT LEAST 50% OF INCIDENT (NEW) HD PATIENTS
  - 2. AVF USE IN AT LEAST 40% OF PREVALENT (EXISTING) HD PATIENTS
  - 3. CHRONIC CATHETER (3 MONTHS) USE IN 10% OF PREVALENT HD PATIENTS

TUNNELED CATHETER

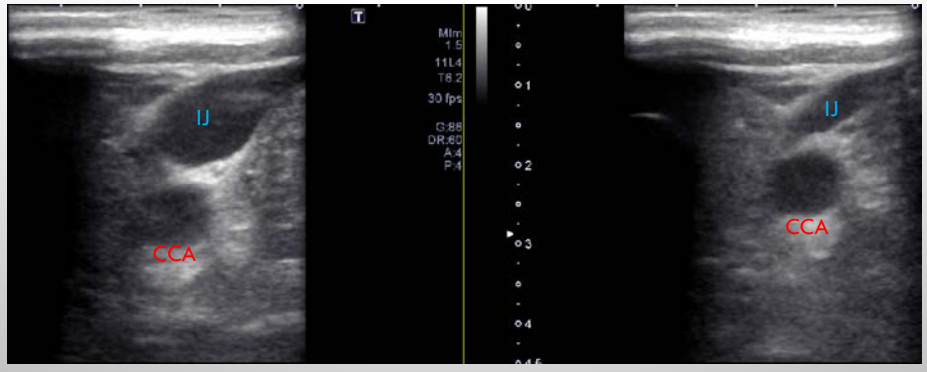
ADVANTAGES:

- DOES NOT REQUIRE SURGERY
- EASE OF ACCESS

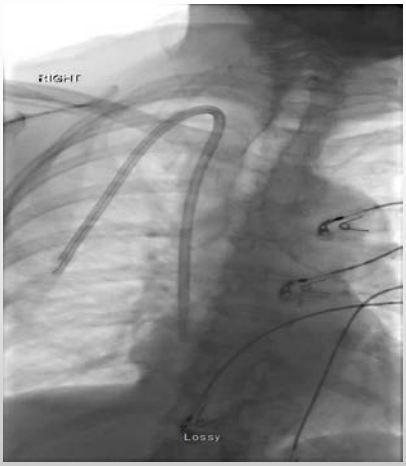
DISADVANTAGES:

- HIGH RISK OF INFECTION
- CATHETER EXPOSED
- UNABLE TO SHOWER

TUNNELED CATHETER



TUNNELED CATHETER



ARTERIO VENOUS ACCESS ADVANTAGES

- RESISTANT TO INFECTION (VEIN>GRAFT)
- EASIER FLOW EXCHANGES
- THERE'S NO EXPOSED CATHETERS
- PATIENT CAN SHOWER

CASE #1

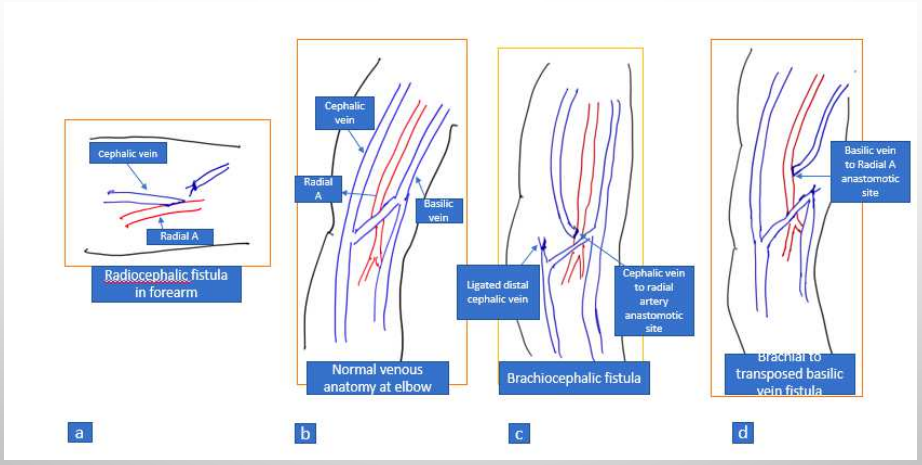
- 63 YO MALE H/O DIABETES, HYPERTENSION, CHRONIC KIDNEY DISEASE STAGE 4 PROGRESSING TO ESRD. RIGHT-HANDED DOMINANT

- FISTULA FIRST APPROACH, NEXT STEP?

VEIN MAP

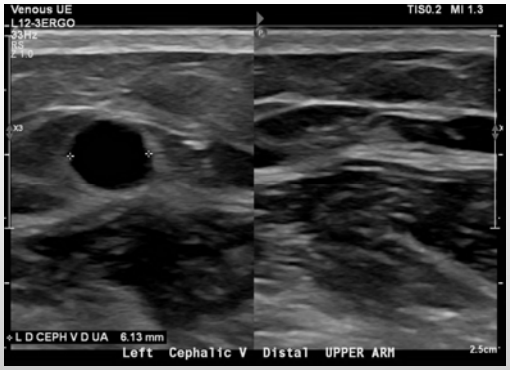
- BILATERAL
- ANATOMY AND DIAMETERS
- IDEALLY:
  - RADIAL ARTERY >2.5MM
  - BRACHIAL ARTERY >3.0MM
  - UPPER ARM CEPHALIC VEIN > 3.5MM
  - UPPER ARM BASILIC VEIN > 4.5MM

AVF OPTIONS



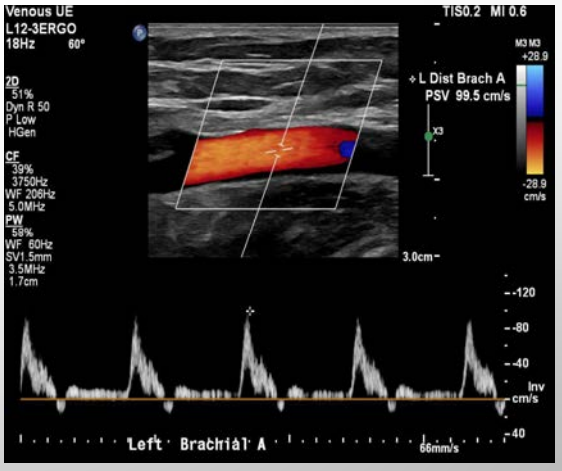
M. R. Bursupalle, et al.Dialysis Access Arteriovenous fistulas – complications and management through interventional radiology techniques. EPOS

VEIN MAP

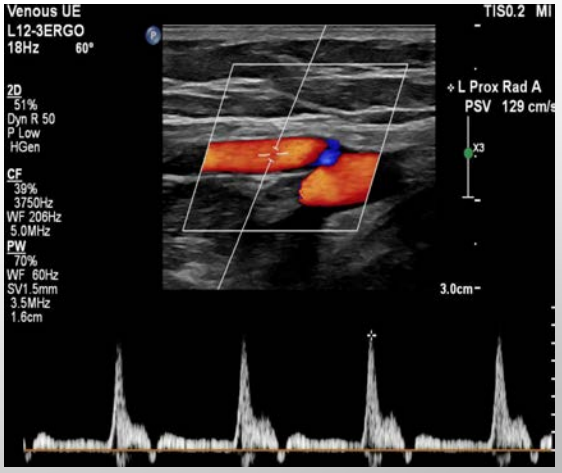


VEIN MAP

VEIN MAP



VEIN MAP



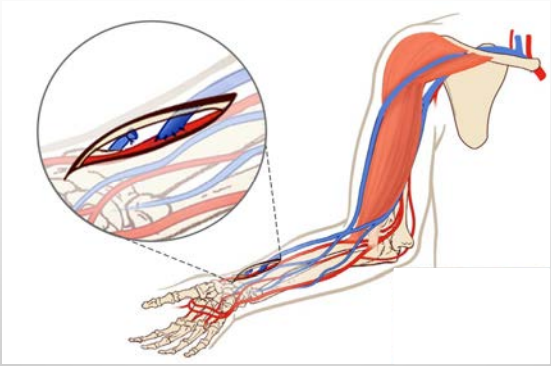
VEIN MAP

	Radial Artery		Ulnar Artery		Brachial Artery	
	Right	Left	Right	Left	Right	Left
Diameter(mm)(min>2mm)	4.2	4.8	6.3	5.8	6.5	7.8
Calcification (Y/N)	N	N	N	N	N	N
PSV (cm/sec)	112	129	118	117	115	100
EDV (cm/sec)	–	–	–	–	–	–
High Brachial Bif (Y/N)	N	N	N	N	N	N

Comments: _____

Min diameter >2.5mm	Cephalic Vein Diameter (mm)		Basilic Vein Diameter (mm)	
	Right	Left	Right	Left
Distal Forearm	3.7	3.5	1.7	1.7
Mid Forearm	4.6	4.4	2.5	2.0
Proximal Forearm	4.1	4.1	2.9	2.9
Antecubital Fossa	4.6	4.9	2.5	3.1
Distal Arm	5.9	6.1	6.8	3.4
Mid Arm	5.8	5.9	7.3	6.8
Proximal Arm	6.5	5.3	7.6	6.8

RADIO-CEPHALIC FISTULA



Tushar J, Vachharajani, Atlas of Dialysis Vascular access

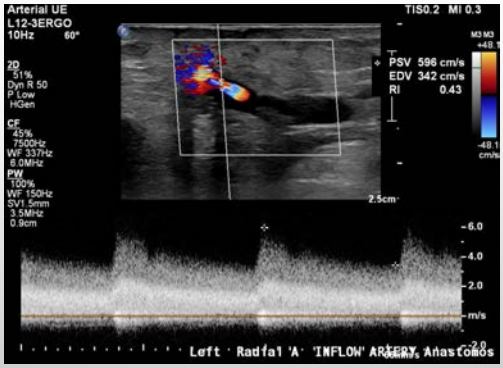
SURVEILLANCE HEMODIALYSIS ULTRASOUND

- PSV 150-400 CM/S, RATIO < 3:1
- EDV 60-250 CM/S , LOW RESISTANCE SIGNAL WITH SPECTRAL BROADENING
- PRESENCE OF COLOR THROUGHOUT THE FISTULA
- FLOW VOLUME 500-2500 ML/MIN (500-900 CONSIDER SLOW MATURATION)

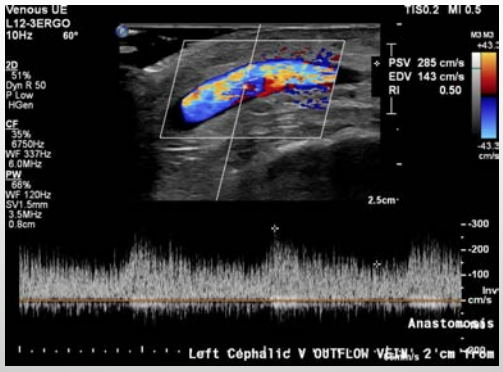
MATURATION

- DIAMETER >4MM
- DEPTH <5MM
- FLOW >500 ML/MIN
- RULE OF SIX'S:
  - 6MM DIAMETER
  - 6MM DEPTH
  - 600ML/MIN

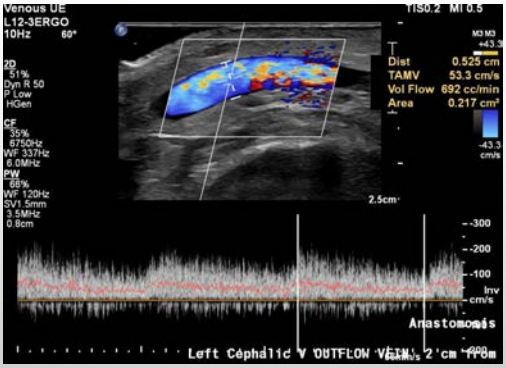
POST OP



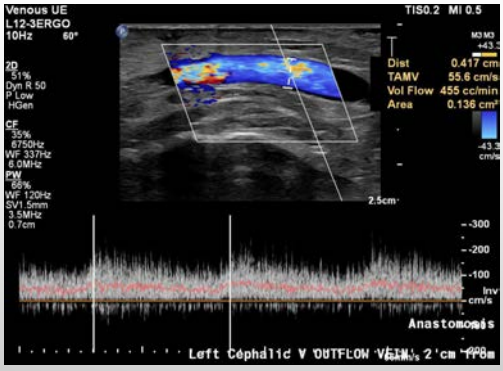
POST OP



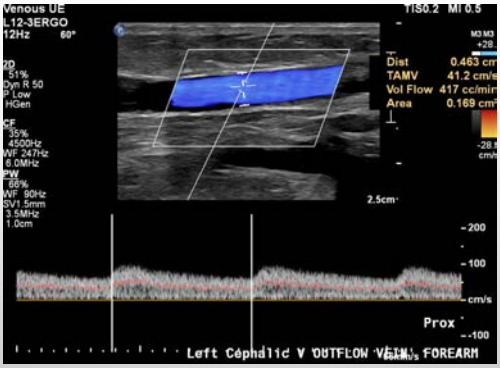
POST OP



POST OP



POST OP



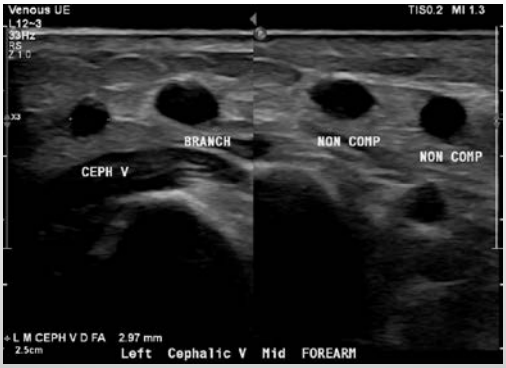
RADIO-CEPHALIC FISTULA

CASE#2

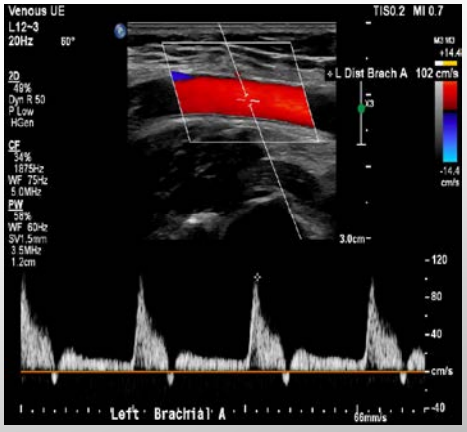
- 74 YO RIGHT-HANDED MALE, H/O POLYCYSTIC KIDNEY DISEASE, CKD4 NEAR ESRD.
- NEXT STEP

VEIN MAP

VEIN MAP



VEIN MAP



VEIN MAP

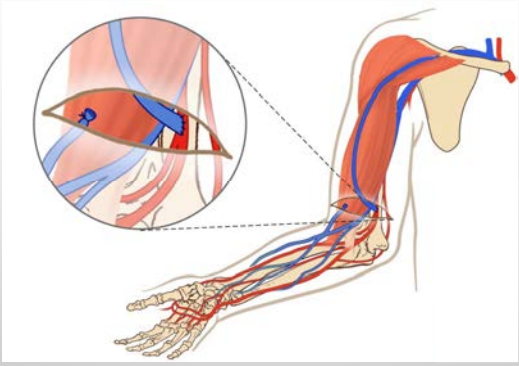
	Radial Artery	Ulnar Artery	Brachial Artery
Diameter (mm) (min>2mm)	4.5	4.5	6.4
Calcification (Y/N)	N	N	N
PSV (cm/sec)	102	92	97
EDV (cm/sec)	/	/	/
High Brachial Bif (Y/N)	N	N	N

Comments:

(minimum diameter >2.5mm)	Cephalic Vein Diameter (mm)	Basilic Vein Diameter (mm)
Distal Forearm	4.0	3.5 Branches
Mid Forearm	4.8	2.1
Proximal Forearm	3.7	2.9
Antecubital Fossa	4.0	5.1 Branches
Distal Arm	4.0 ⊕ Superficial thrombus	5.4 Branches
Mid Arm	2.8	5.1
Proximal Arm	2.7	5.8

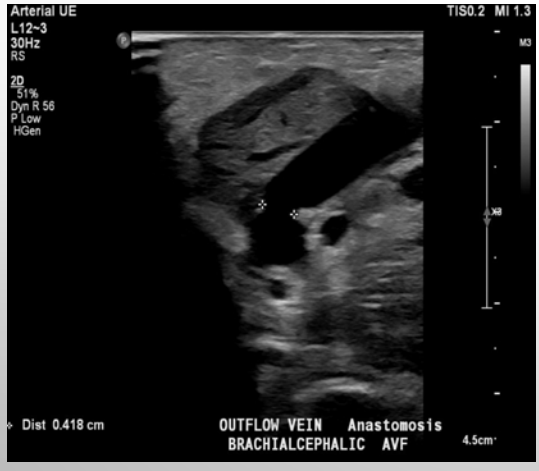
Comments: ⊕ nonocclusive superficial thrombus in ceph v ACF @ IV site

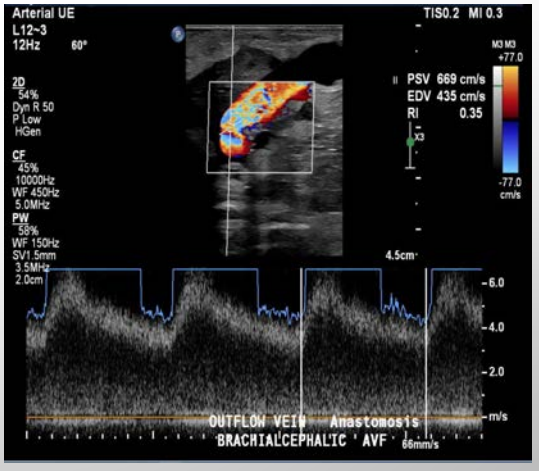
BRACHIO-CEPHALIC FISTULA



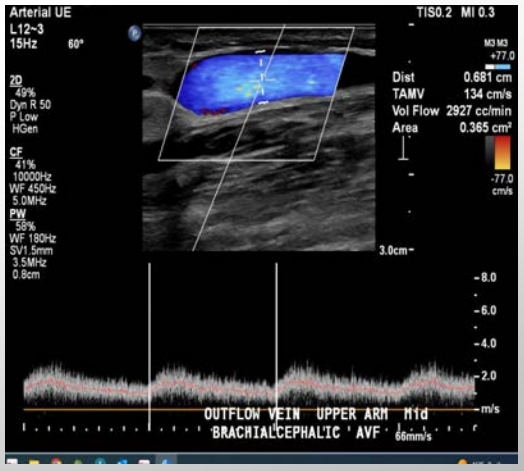
Tushar J, Vachharajani, Atlas of Dialysis Vascular access

POST OP

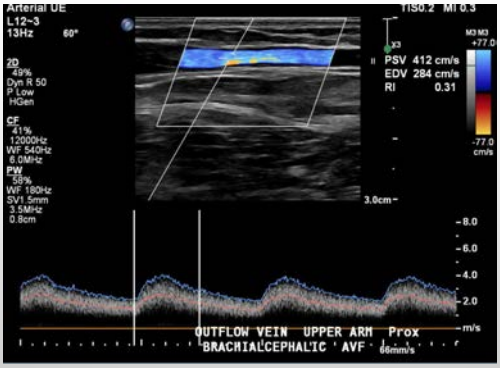




POST OP



POST OP



CASE #3

- 56 YO MALE, RIGHT HAND DOMINANT WITH HISTORY OF TYPE 2 DIABETES AND PERIPHERAL VASCULAR DISEASE CKD STAGE 4 PROGRESSING TO END STAGE RENAL DISEASE (ESRD)

- FISTULA FIRST APPROACH, NEXT STEP?

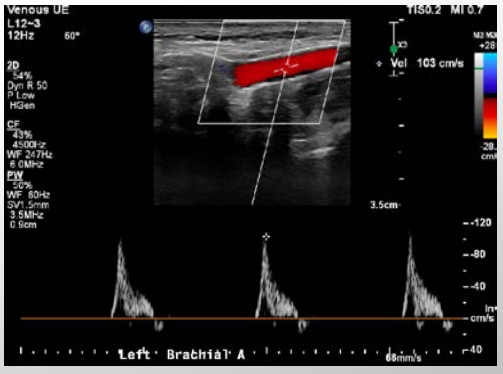
VEIN MAP

VEIN MAP

VEIN MAP

VEIN MAP

VEIN MAP



VEIN MAP

VEIN MAP

VEIN MAP

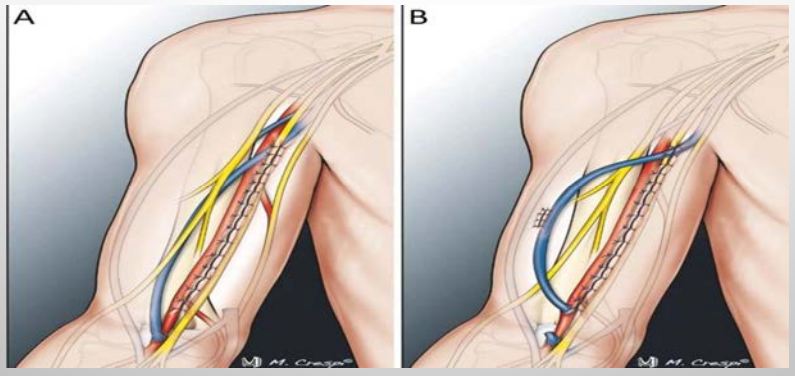
	Radial Artery	Ulnar Artery	Brachial Artery
Diameter (mm) (min>2mm)	3.4	4.6	5.6
Calcification (Y/N)	Yes	Yes	Yes
PSV (cm/sec)	62	70	62
EDV (cm/sec)	/	/	/
High Brachial Bif (Y/N)	NO	NO	NO

Comments: _____

(minimum diameter >2.5mm)	Cephalic Vein Diameter (mm)	Basilic Vein Diameter (mm)
Distal Forearm	2.1	2.7
Mid Forearm	4.1	2.11
Proximal Forearm	5.0	2.8
Antecubital Fossa	2.5	2.8
Distal Arm	2.3	3.1
Mid Arm	1.9	3.3
Proximal Arm	2.0	5.1

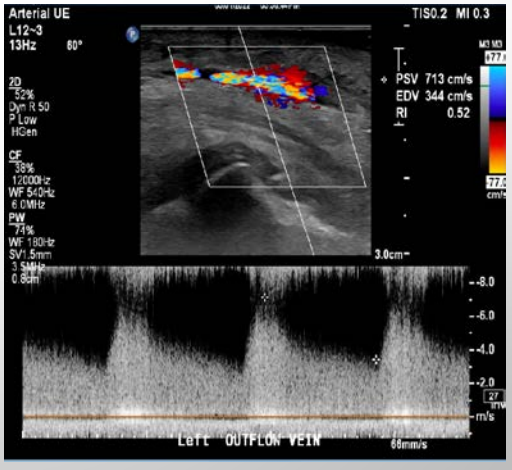
BASILIC VEIN TRANSPOSITION

- 1 VS 2 STAGES

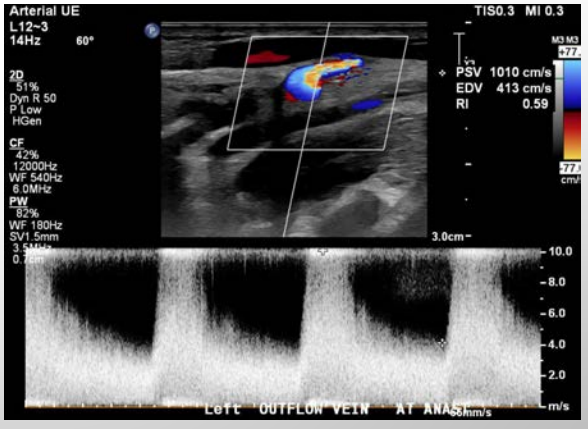


Mauro R, Pini R, et al. A Comparison of Two Surgical Techniques for the Second Stage of Brachiobasilic Arteriovenous Fistula Creation. Artif Organs. 2017 Jun;41(6):539-544

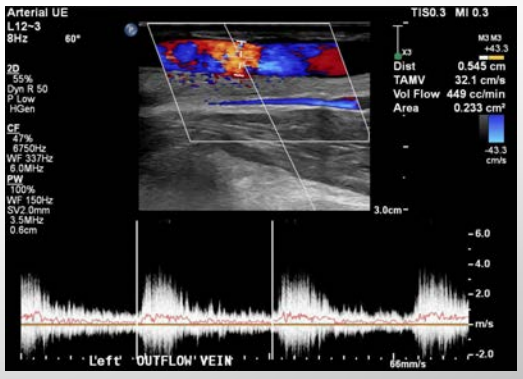
POST OP



POST OP



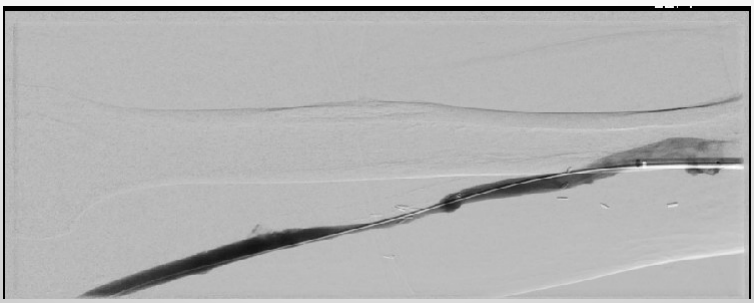
POST OP



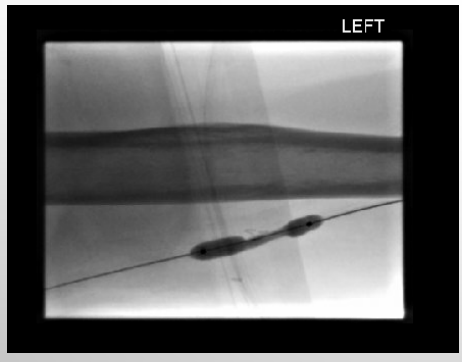
FAILURE TO MATURE

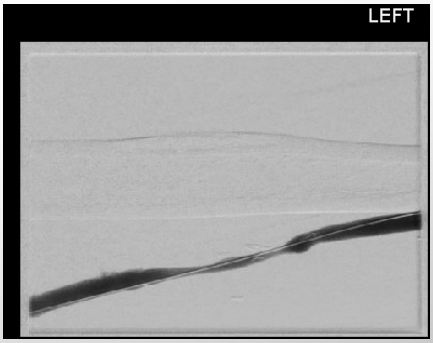
- BETWEEN 40-50%
- CONTINUE MONITORING VS INTERVENTION
- FISTULOGRAM POSSIBLE ANGIOPLASTY/STENT

FISTULOGRAM

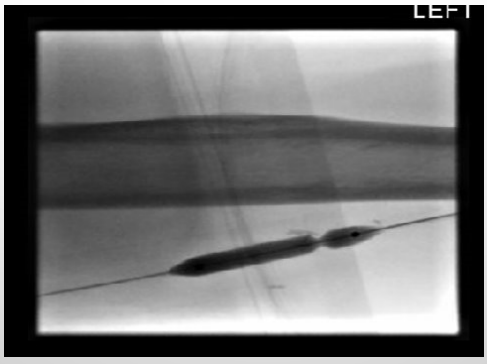


DRUG COATED BALLOON ANGIOPLASTY

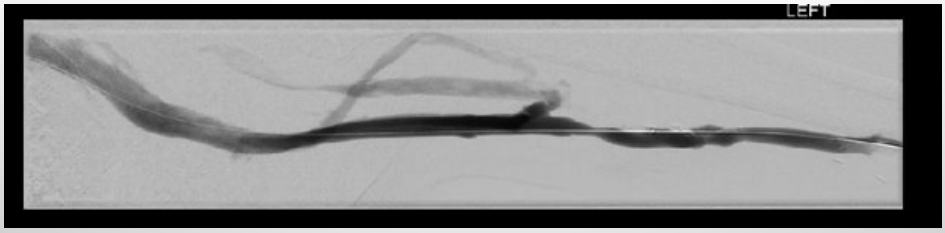




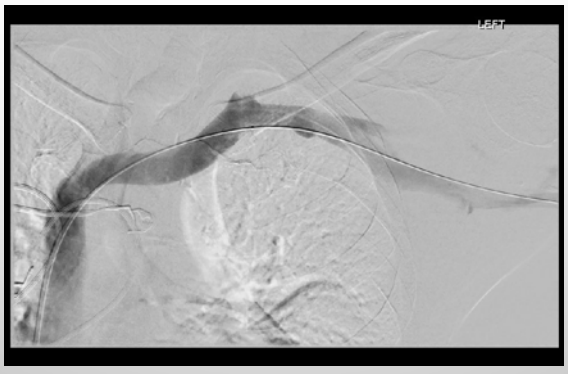
DRUG COATED BALLOON ANGIOPLASTY



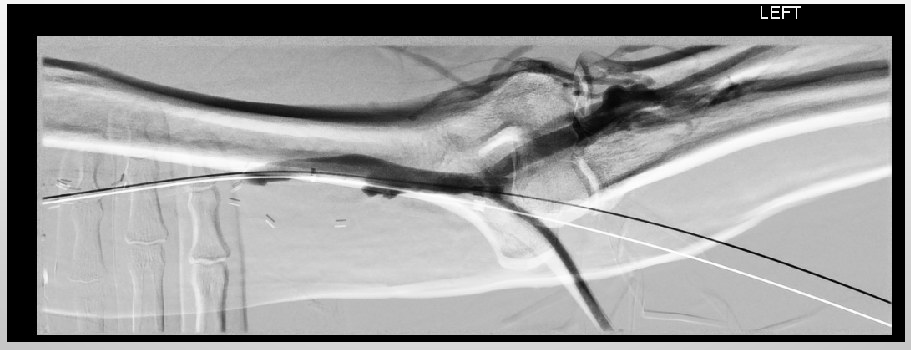
DCB



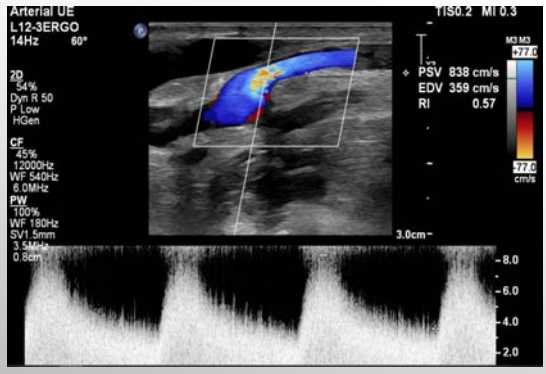
CENTRAL VEINS

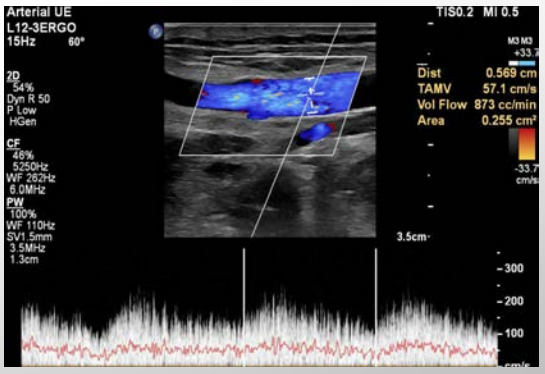


INFLOW



POST FISTULOGRAM

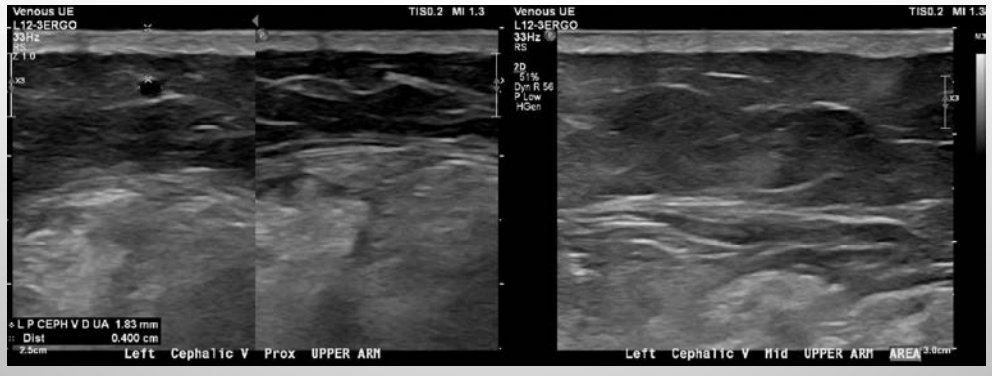




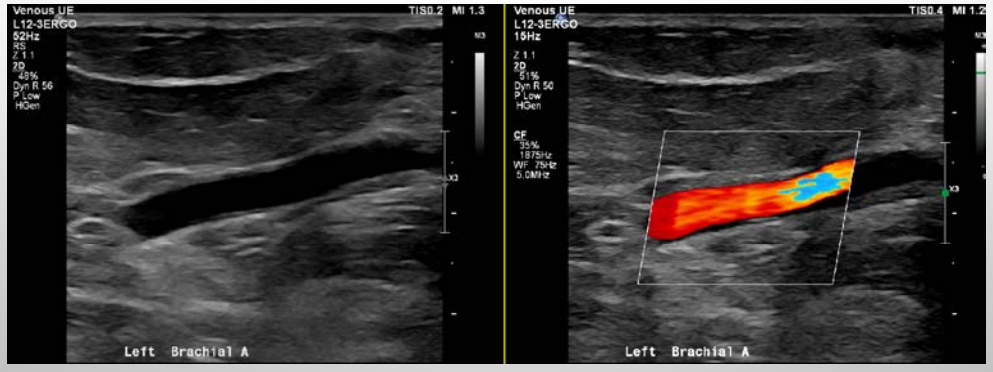
CASE #4

- 75 YO FEMALE H/O DM, MORBID OBESITY, ESRD WITH A PREVIOUS BRACHIOBASILIC FISTULA THAT FAILED TO MATURE.
- NEXT STEPS?

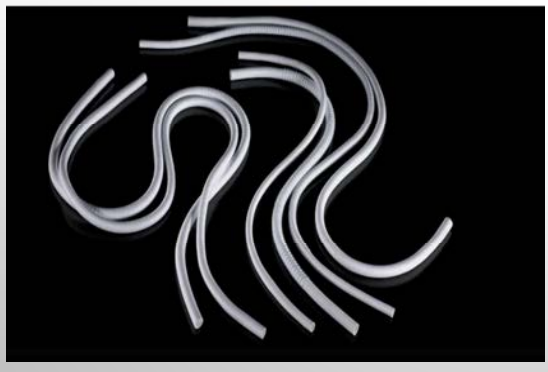
VEIN MAP



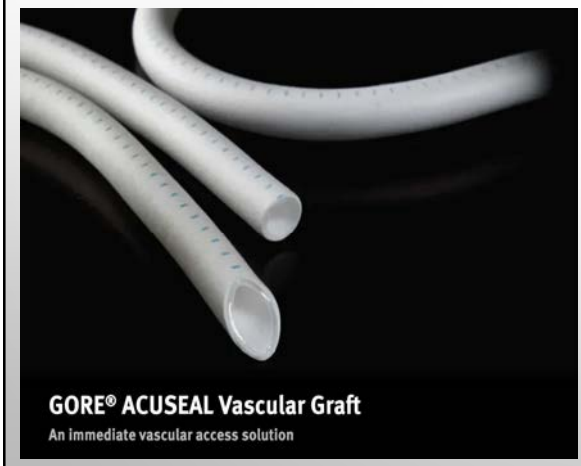
VEIN MAP

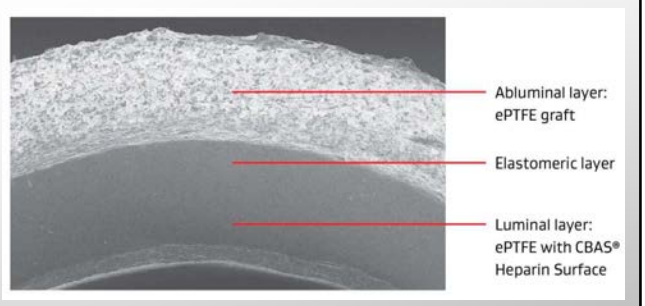


ARTERIOVENOUS GRAFT (AVG)

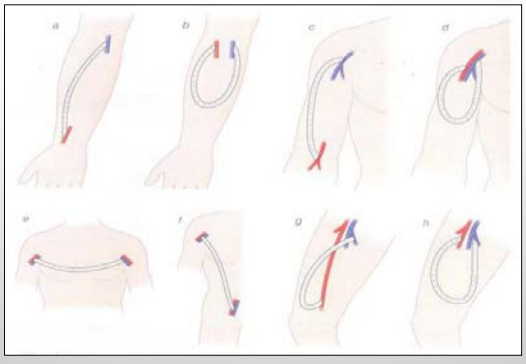


RAPID ACCESS GRAFT



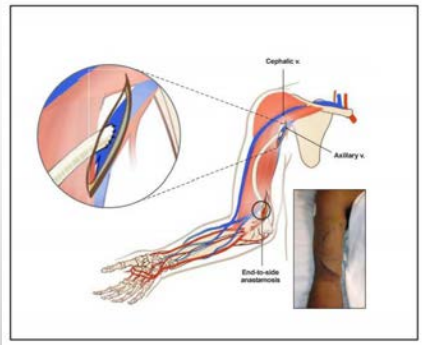


GRAFT CONFIGURATION



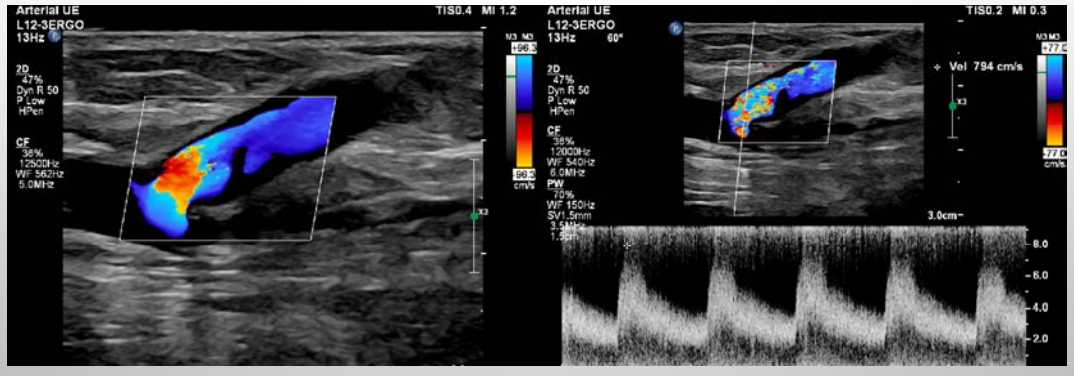
Ammar Almehmi, MD, MPH, Interventional Nephrology Primer: Part 1 Fistulas, Grafts, Catheters and PICC lines 2020

GRAFT CONFIGURATION

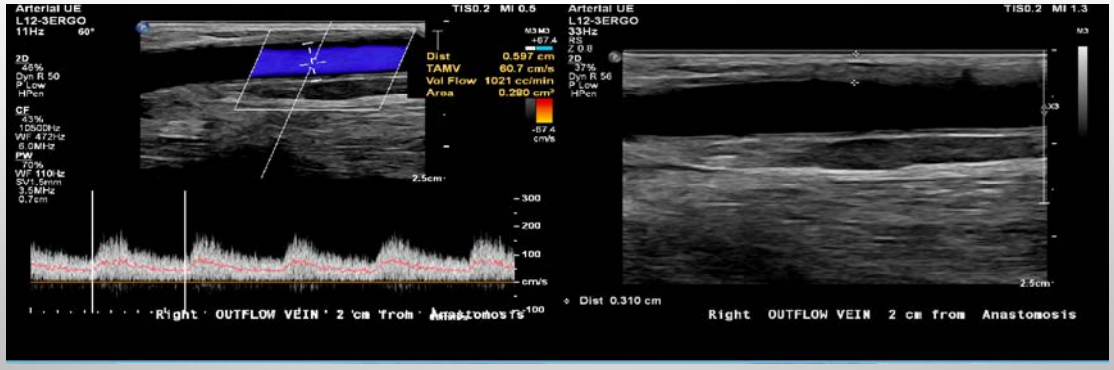


Tushar J, Vachharajani, Atlas of Dialysis Vascular access

POST OP



POST OP



COMPLICATIONS

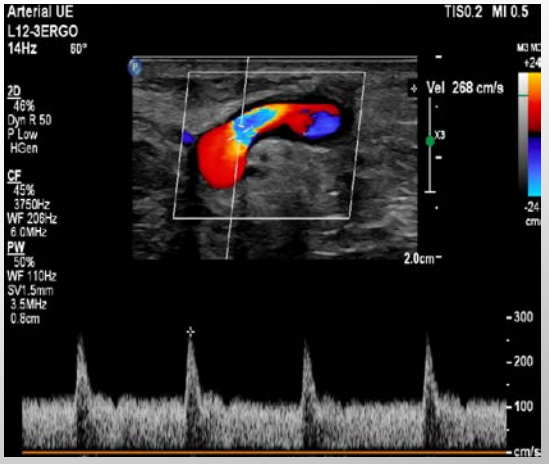
- NON-MATURATION
- THROMBOSIS
- INFECTION
- STEAL
- ANEURYSMAL DEGENERATION
- EDEMA (CENTRAL VEIN STENOSIS)

CASE #5 (THROMBOSIS)

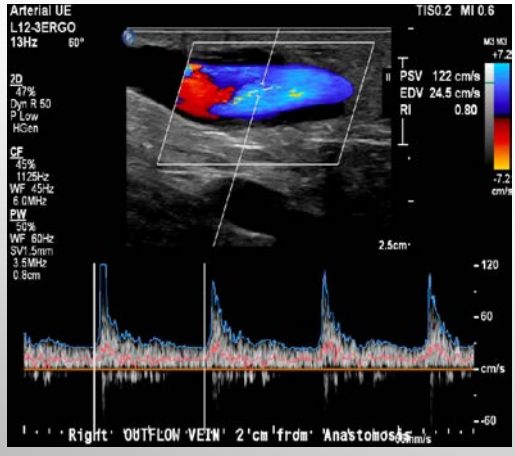
- 45 YO MALE, LEFT HAND DOMINANT, CURRENTLY RECEIVING DIALYSIS TROUGH 2 YEAR OLD RIGHT BRACHIOBASILIC FISTULA THAT HAD MULTIPLE ANGIOPLASTIES IN THE PAST.

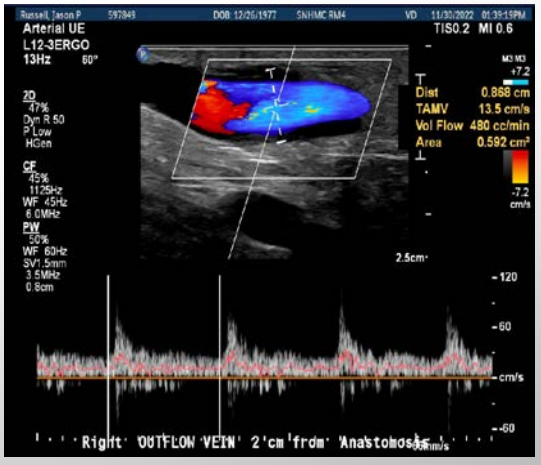
WE ARE CALLED FROM DIALYSIS BECAUSE STAFF IS UNABLE TO FEEL THRILL ON THE FISTULA

PREVIOUS US

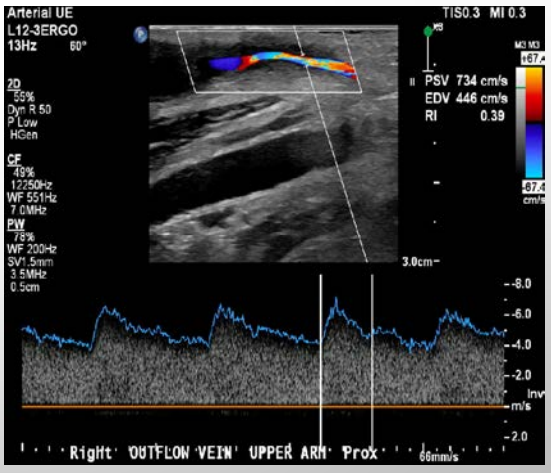


PREVIOUS US

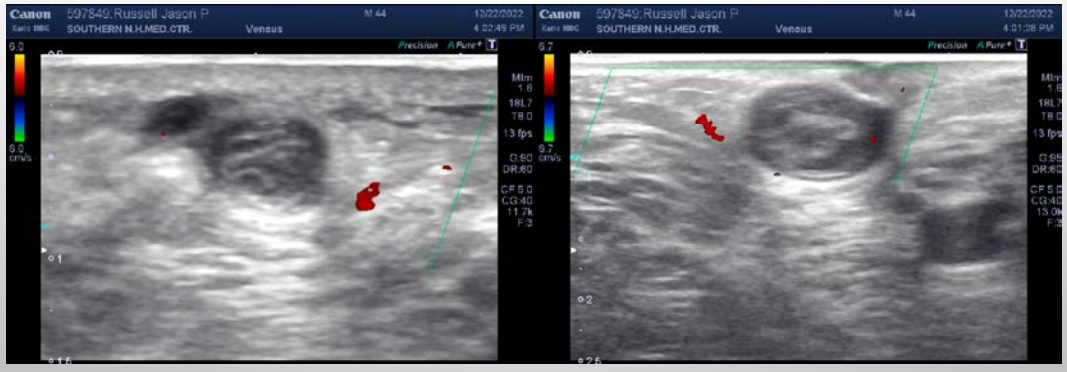




PREVIOUS US



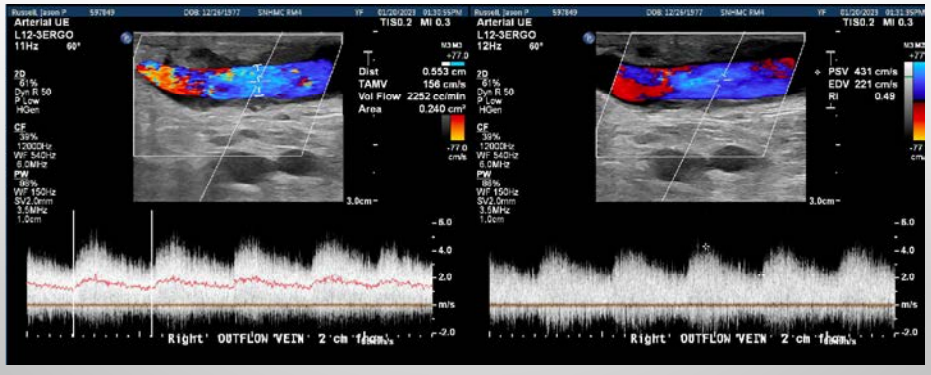
CURRENT US



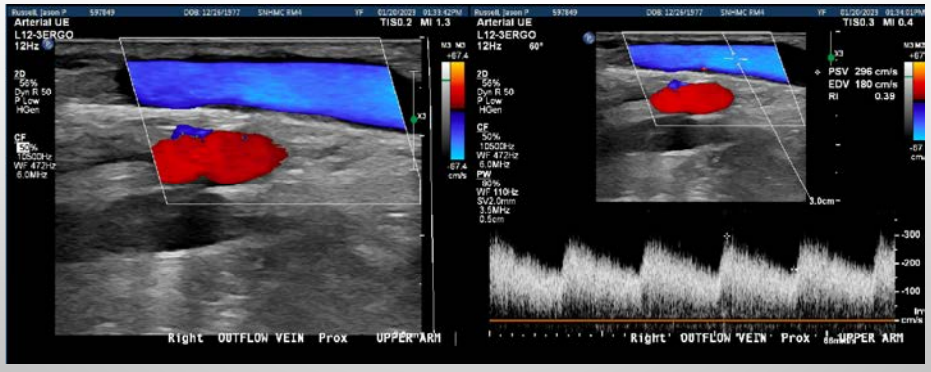
FISTULOGRAM

CATH PLACEMENT

POST OP



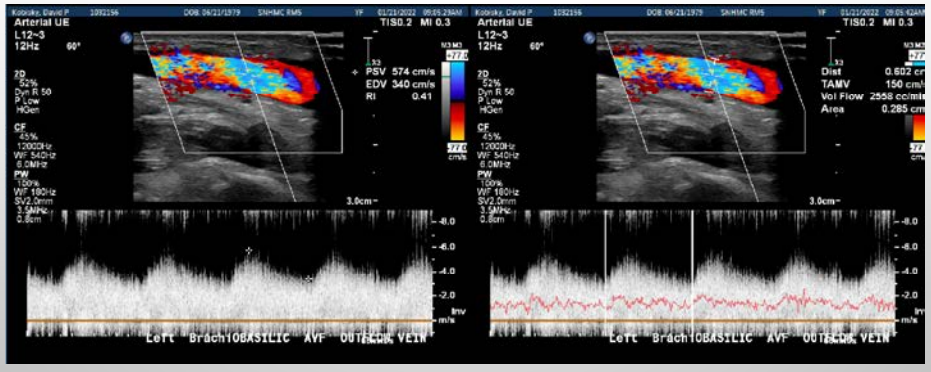
POST OP



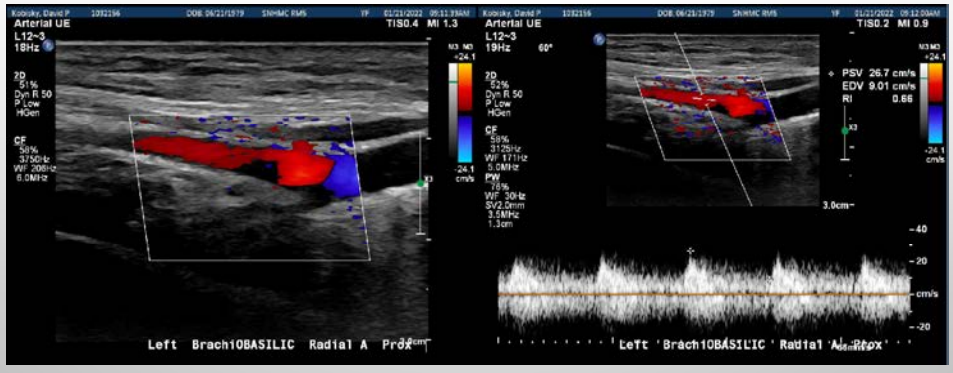
CASE #6

- 43 YO MALE H/O ESRD, LEFT HAND DOMINANT, ON HD TROUGHT A 1 YEAR OLD RIGHT BRACHIOBASILIC FISTULA, COMPLAINING OF RIGHT HAND PAIN AND CHRONIC ULCERS ON HIS FINGERS

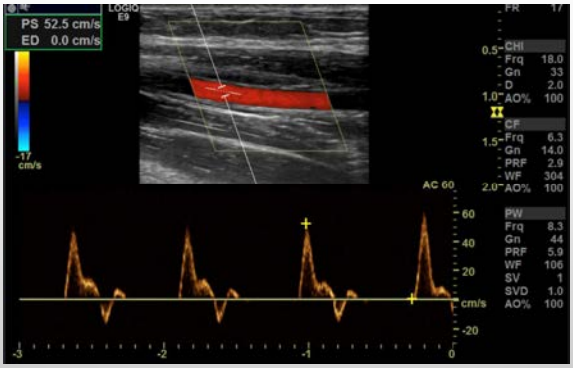
HD US


Arterial UE
L12-3
12Hz
PSV 574 cm/s
EDV 340 cm/s
RI 0.41
Left Brach1OBASILIC AVF OUTFLOW VEIN
Arterial UE
L12-3
12Hz
Left Brach1OBASILIC AVF OUTFLOW VEIN

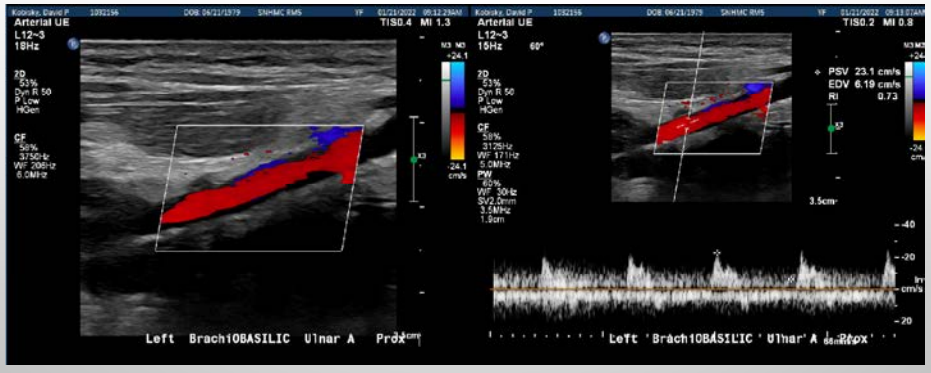
HD US


Arterial UE
L12-3
18Hz
Left Brach1OBASILIC Radial A Prox
Arterial UE
L12-3
19Hz
PSV 26.7 cm/s
EDV 9.01 cm/s
RI 0.66
Left Brach1OBASILIC Radial A Prox

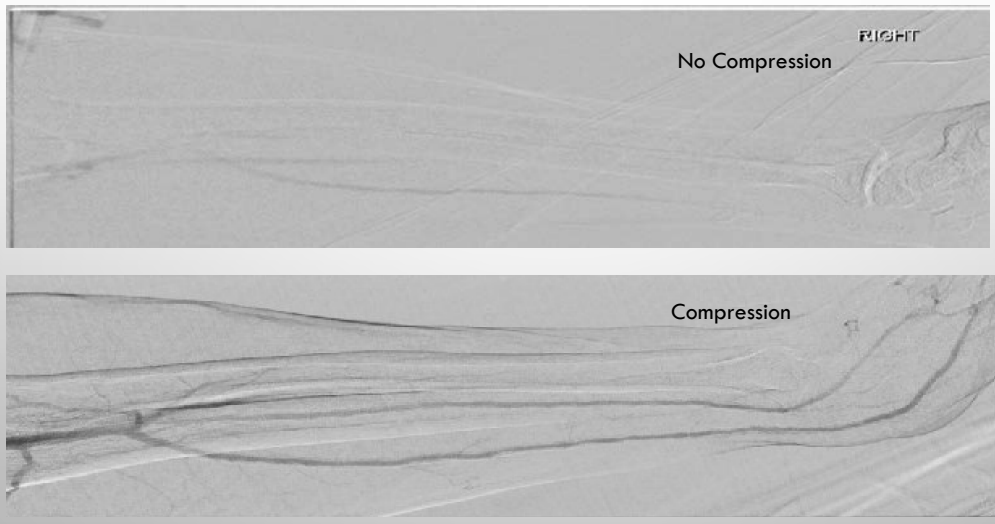
NORMAL RADIAL WAVEFORM



HD US



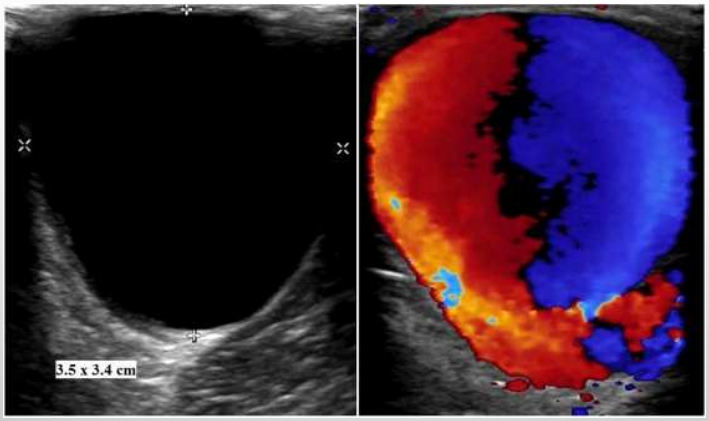
FISTULOGRAM



CASE #7 (ANEURYSMAL DEGENERATION)

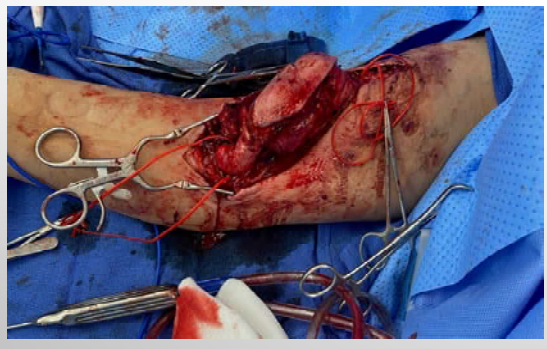
- 66 YO DM, ESRD ON HD TROUGH LEFT BRACHICEPHALIC FISTULA FOR THE PAST 6 YEARS, NOW WITH SIGNIFICANT ENLARGEMENT AT FISTULA ACCESS SITE

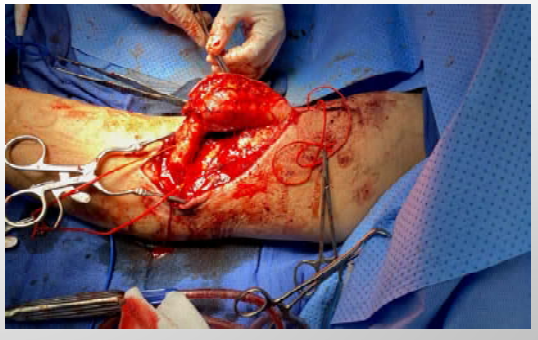
US



Garri Pasklinsky, et al.,Management of true aneurysms of hemodialysis access fistulas, Journal of Vascular Surgery,Volume 53, Issue 5,2011, Pages 1291-129

SURGERY





SURGERY

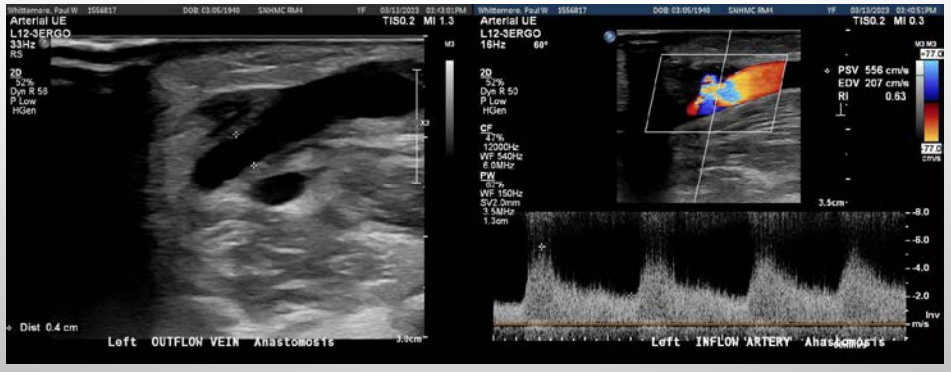
SURGERY

CASE #8

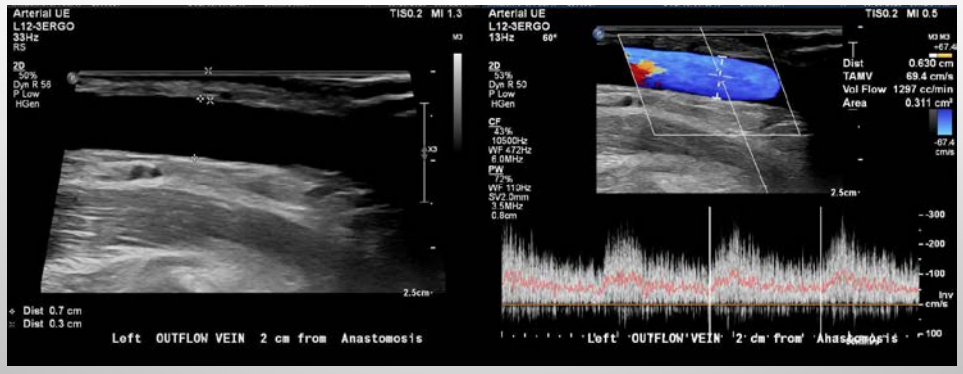
- 83 YO RIGHT HAND DOMINANT, PRESENTS 4 WEEKS FOLLOWING CREATION OF LEFT BRACHIOBASILIC AVF, C/O SEVERE LEFT ARM EDEMA AND A SMALL WOUND OPENING. PREVIOUS H/O HEART BLOCK S/P LEFT SUBCLAVIAN PACEMAKER PLACEMENT.

CENTRAL VENOUS STENOSIS

ULTRASOUND



ULTRASOUND



CT SCAN

MASSACHUSETTS GENERAL HOSPITAL
FIREMAN VASCULAR CENTER

THANK YOU

HARVARD MEDICAL SCHOOL