2023 MID-ATLANTIC CONFERENCE

11th ANNUAL CURRENT CONCEPTS IN

VASCULAR THERAPIES

2023

Hilton Virginia Beach Oceanfront
Virginia Beach, Virginia

APRIL 20-22

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VASCULAR THERAPIES

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Is PVL an order or a location?

Introduction to Vascular Imaging

Michael E Landis, MD FACS

Sentara
Peripheral Vascular Lab

“Get a PVL”

- Sentara Dedicated Vascular Service Line
  - technologists/varying levels of competency
  - 19 Physical Locations
  - Offer interventional/surgical/trauma services
- Same protocols, same equipment and reporting software at all sites.
- Peripheral Vascular Lab – a place not a test

ICAVL/IAC certification

- Internally validated diagnostic criteria with retrievable records
- Recertification every three years.
- Requires information on technician/medical director training, procedural volumes, equipment information and CME

EPIC VASCULAR ORDERS

Name
PVL DIALYSIS ACCESS SCAN LE RIGHT
PVL DIALYSIS ACCESS SCAN UE LEFT
PVL DIALYSIS ACCESS SCAN UE RIGHT
PVL DIALYSIS ACCESS STEAL STUDY LEFT UE
PVL DIALYSIS ACCESS STEAL STUDY RIGHT UE
PVL DIGITAL PRESSURES (FINGERS)
PVL DIGITAL PRESSURES (TOES)
PVL EPIGASTRIC ARTERY DUPLEX
PVL GRAFT DUPLEX LE BILAT
PVL GRAFT DUPLEX LE LEFT
PVL GRAFT DUPLEX LE RIGHT
PVL GRAFT DUPLEX UE BILAT
PVL GRAFT DUPLEX UE LEFT
PVL GRAFT DUPLEX UE RIGHT
PVL GROIN STUDY BILAT
PVL GROIN STUDY LEFT
PVL GROIN STUDY RIGHT
PVL ILIAC ARTERY IMAGING BILAT
PVL ILIAC ARTERY IMAGING LEFT
PVL ILIAC ARTERY IMAGING RIGHT
PVL INTERNAL MAMMARY ARTERY BILATERAL
PVL INTERNAL MAMMARY ARTERY LEFT
PVL INTERNAL MAMMARY ARTERY RIGHT
PVL INTRA OP AORTA ILIAC DUPLEX
PVL INTRAOP CAROTID DUPLEX
PVL INTRAOP GRAFT DUPLEX
PVL INTRAOP LE ART DUPLEX BILAT
PVL INTRAOP LE ART DUPLEX UNI/LTD
PVL INTRAOP UE ART DUPLEX BILAT

Name
PVL INTRAOP UE ART DUPLEX UNI/LTD
PVL INTRAOP VISCERAL DUPLEX
PVL IVC (INCLUDES IVC/ILIAC VEINS)
PVL IVC FILTER PLACEMENT
PVL LIVER TRANSPLANT
PVL MANUAL OCCLUSION OF PSEUDOAN
PVL MESENTERIC SCAN
PVL ORDERSET 981
PVL PANCREATIC TRANSPLANT
PVL PENILE DUPLEX NO INJECTION
PVL PENILE DUPLEX W/INJECTION
PVL POPLITEAL ARTERY DUPLEX BILAT
PVL POPLITEAL ARTERY DUPLEX LEFT
PVL POPLITEAL ARTERY DUPLEX RIGHT
PVL PORTABLE CHARGE VASCULAR LAB
PVL PORTAL-HEPATIC
PVL POST ABLATION DUPLEX SCAN BILATERA
PVL POST ABLATION DUPLEX SCAN LEFT
PVL POST ABLATION DUPLEX SCAN RIGHT
PVL PV DIGITIZED IMAGES
PVL RADIAL ARTERY (PREOP)/ALLEN TEST
PVL RADIAL ARTERY DUPLEX BILAT
PVL RADIAL ARTERY DUPLEX LEFT
PVL RADIAL ARTERY DUPLEX RIGHT
PVL RENAL ARTERY/VEIN BILATERAL
PVL RENAL ARTERY/VEIN LEFT
PVL RENAL ARTERY/VEIN RIGHT
PVL RENAL TRANSPLANT
PVL SCANNED IMAGE

Name
PVL TEMPORAL ARTERY BILATERAL
PVL TEMPORAL ARTERY LEFT
PVL TEMPORAL ARTERY RIGHT
PVL THORACIC OUTLET DUPLEX BILATER
PVL THORACIC OUTLET DUPLEX LEFT
PVL THORACIC OUTLET DUPLEX RIGHT
PVL THROMBIN INJECTION OF PSEUDOA
PVL TIPS
PVL TRANSCRANIAL DUPLEX COMPLETE
PVL TRANSCRANIAL DUPLEX LIMITED
PVL TRAUMA SCAN LE BILAT
PVL TRAUMA SCAN LE LEFT
PVL TRAUMA SCAN LE RIGHT
PVL TRAUMA SCAN UE BILAT
PVL TRAUMA SCAN UE LEFT
PVL TRAUMA SCAN UE RIGHT
PVL TYPE-IN
PVL UNLISTED PROCEDURE
PVL VEIN MAP UE PRE OP DIALYSIS ACCESS BILAT
PVL VEIN MAP UE PRE OP DIALYSIS ACCESS LT
PVL VEIN MAP UE PRE OP DIALYSIS ACCESS RT
PVL VEIN MAP UE REVASCULARIZATION BILAT
PVL VEIN MAP UE REVASCULARIZATION LT
PVL VEIN MAP UE REVASCULARIZATION RT
PVL VEIN MAPPING LE BILATERAL
PVL VEIN MAPPING LE BILATERAL FOR DEEP VEINS
PVL VEIN MAPPING LE LEFT
PVL VEIN MAPPING LE LEFT FOR DEEP VEINS
PVL VEIN MAPPING LE RIGHT

Name
PVL VENOUS EXAM LE BILATERAL R/O DVT
PVL VENOUS EXAM LE LEFT R/O DVT
PVL VENOUS EXAM LE RIGHT R/O DVT
PVL VENOUS EXAM UE BILATERAL R/O DVT
PVL VENOUS EXAM UE LEFT R/O DVT
PVL VENOUS EXAM UE RIGHT R/O DVT
PVL VENOUS INSUFFICIENCY LE BILATERAL
PVL VENOUS INSUFFICIENCY LE LEFT
PVL VENOUS INSUFFICIENCY LE RIGHT
PVL IVC (INCLUDES IVC/ILIAC VEINS)
ED PVL VENOUS EXAM LE BILATERAL
ED PVL VENOUS EXAM LE LEFT
ED PVL VENOUS EXAM LE RIGHT

Sentara Vascular Laboratories

2022 PVL exam total= 87,792

LE Venous= 32,170 exams
- ER= 30%
- Inpatient= 32%
- Outpatient= 33%

Venous Insufficiency= 3551 exams

UE Venous= 4183 patients

Extracranial= 14,296 exams

LE arterial= 15,414 exams

Aorta/EVAR= 2718 exams

Renal= 2454 exams

Dialysis Access= 2058 exams

Types of Vascular Studies

Extra/Intracranial:

Carotids

Transcranial (neuro)

Extremity Venous:

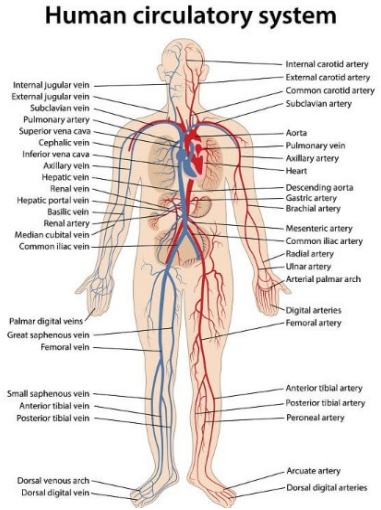
Upper, Lower r/o DVT

Vein mapping

Venous Insufficiency (NOT IP's)

Extremity Arterial Testing:

Physiologic Testing (rest or exercise) includes ABI. **DOPPLER**



Duplex Ultrasound (imaging/**no ABI**)

* Includes groin, grafts, stents, mapping

Abdominal Testing:

Renals, Mesenteric, Portal, TIPS, Transplants
IVC, Aorto-Iliac and EVAR

Advantages of Ultrasound

- Truly non-invasive
- Does not involve the use of ionizing radiation or contrast dye.
- Ideal in the setting of claustrophobia.
- No need for sedation or i.v. access.
- Capital equipment cost 1/10th that of CT or MR scanners.
- Study cost 1/10th of CT, MR or conventional angiography.
- The preferred imaging modality for assessing arteriovenous fistula, arterial bypass grafts, deep and superficial venous thrombus, and venous insufficiency.

CMS Guidelines

- "The use of a simple handheld or other Doppler device that does not produce hard copy output, or that does not permit analysis of bi-directional vascular flow, is considered part of the physical examination of the vascular system and is not separately reimbursable."
- Studies must be performed by, or under the direct supervision of, persons who have … been credentialed in vascular technology, or performed in facilities with laboratories accredited in vascular technology.
- Technician credentials include ARMDS, RVT, and ARRT
- Laboratory accreditation includes ICAVL or SVR.

Reimbursement

•Impact of Medicare denials on noninvasive vascular diagnostic testing.

•…16.8% of 345 venous duplex ultrasound scans, and 11.1% of 343 lower-extremity arterial Doppler scans).
• an abnormal result was found in “32.8% of venous duplex ultrasound scans, and 78.9% of lower-extremity arterial Doppler scans.”
•Most claims were denied based on compliance documentation for medical necessity, and 88.1% were ultimately reimbursed following resubmission.

Vasc Surg. 2001 Nov;34(5):846-53.
Passman MA1, Guzman RJ, Pierce R, Naslund

Indication for evaluation

- History of complaints consistent with arterial insufficiency; claudication or rest pain.
- Exam findings consistent with the presence of ischemia; ulceration, tissue loss, gangrene.
- Aneurysmal disease.
- Findings consistent with thromboembolism.
- Preoperative assessment prior to surgery with abnormal physical exam.
- Blunt or penetrating trauma
- Surveillance of known PVD, AVF/AVG or BPG.

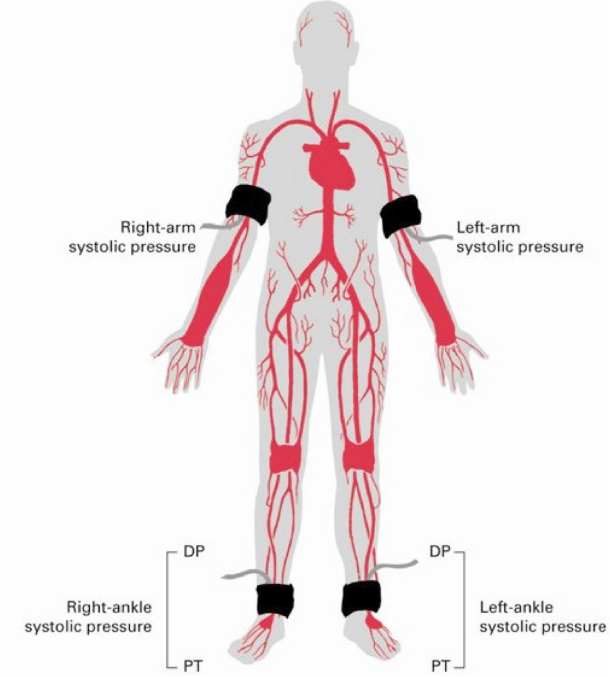
Cost Analysis

CTA		
	Aorta	$5,900
	Upper Extremity	2,175
	Lower Extremity	6,100
MRA		
	Abdomen (excl pelvis)	$4,700
	Lower Extremity	6,700
Conventional angiography		
	Abdomen/Pelvis	$5,800
	Lower extremity	4,000
Duplex		
	Extremity	$410

Disadvantages of Ultrasound

- Anatomic constraints
- Provides only limited evaluation of soft tissue or bone when compared to CT or MR.
- Imaging quality can be limited when assessing deeper structures or small vessels.
- Comparative studies can be difficult to interpret.
- Delay in availability after hours.
- TECHNICIAN DEPENDENT

Ankle–Brachial Index: ABI



Ankle–Brachial Index: ABI

TABLE 1

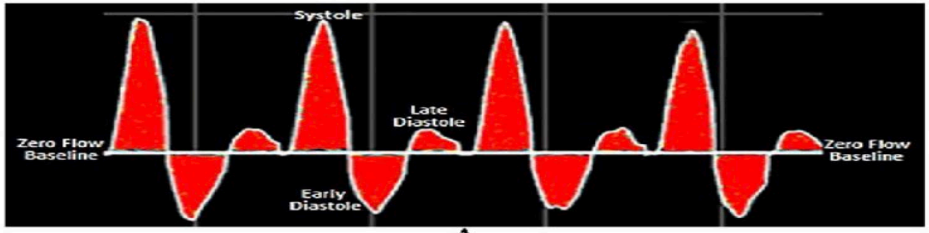
Diagnostic criteria for the resting ankle-brachial index

VALUE	INTERPRETATION
1.00–1.40	Normal
0.91–0.99	Borderline Perform exercise ankle-brachial index testing if indicated
< 0.90	Abnormal—peripheral artery disease
> 1.40	Noncompressible vessels Obtain toe-brachial index to diagnose peripheral artery disease

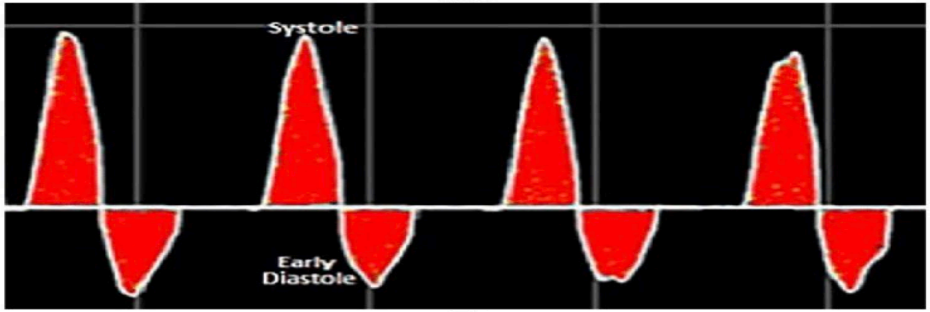
ADAPTED FROM 2011 WRITING GROUP MEMBERS; 2005 WRITING COMMITTEE MEMBERS; ACCF/AHA TASK FORCE MEMBERS. 2011 ACCF/AHA FOCUSED UPDATE OF THE GUIDELINE FOR THE MANAGEMENT OF PATIENTS WITH PERIPHERAL ARTERY DISEASE (UPDATING THE 2005 GUIDELINE): A REPORT OF THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION/AMERICAN HEART ASSOCIATION TASK FORCE ON PRACTICE GUIDELINES. CIRCULATION 2011; 124:2020–2045.

Digital pressures and the Toe–Brachial Index

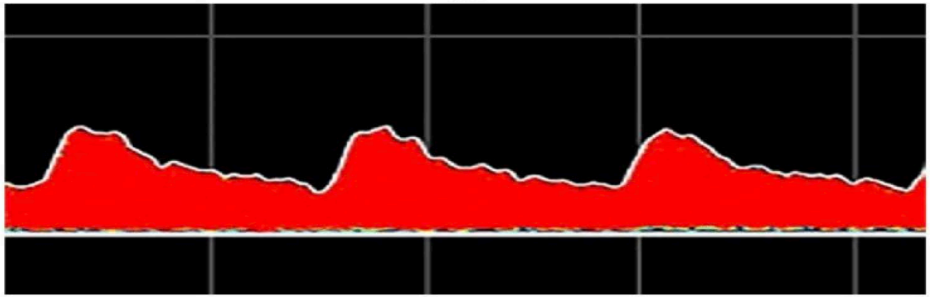
Range	**Interpretation**
>0.7	Normal
0.5-0.7	Mild
0.35-0.5	Moderate
<0.35 and toe pressure 40 mmHg	Moderate-Severe
<0.35 and toe pressure < 30 mmHg	Severe


Systole
Late Diastole
Zero Flow Baseline
Zero Flow Baseline
Early Diastole

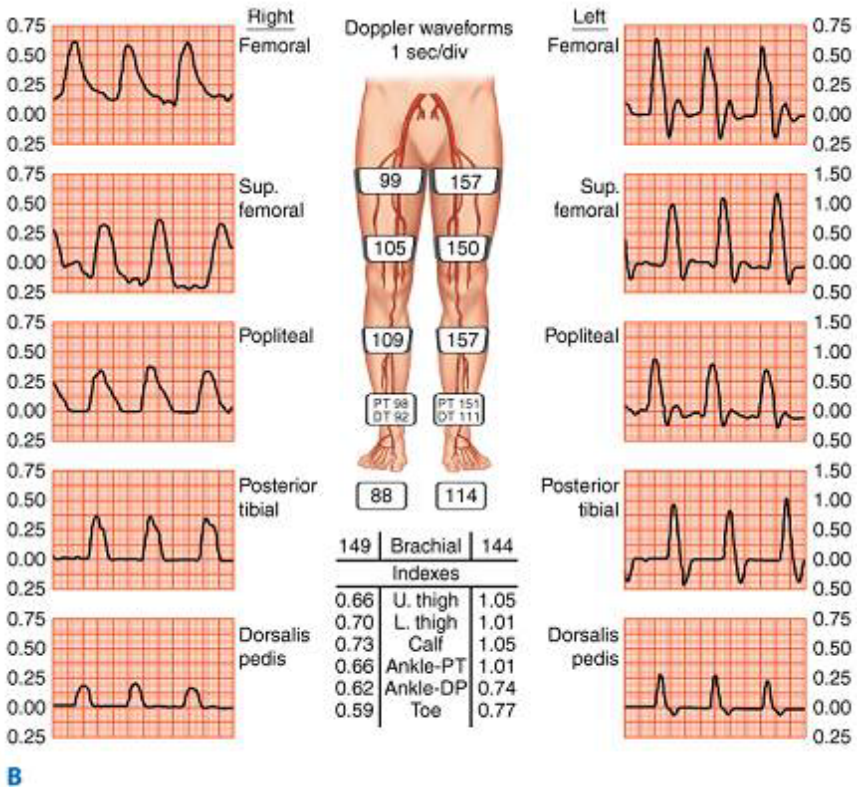
A


Systole
Early Diastole

B



C

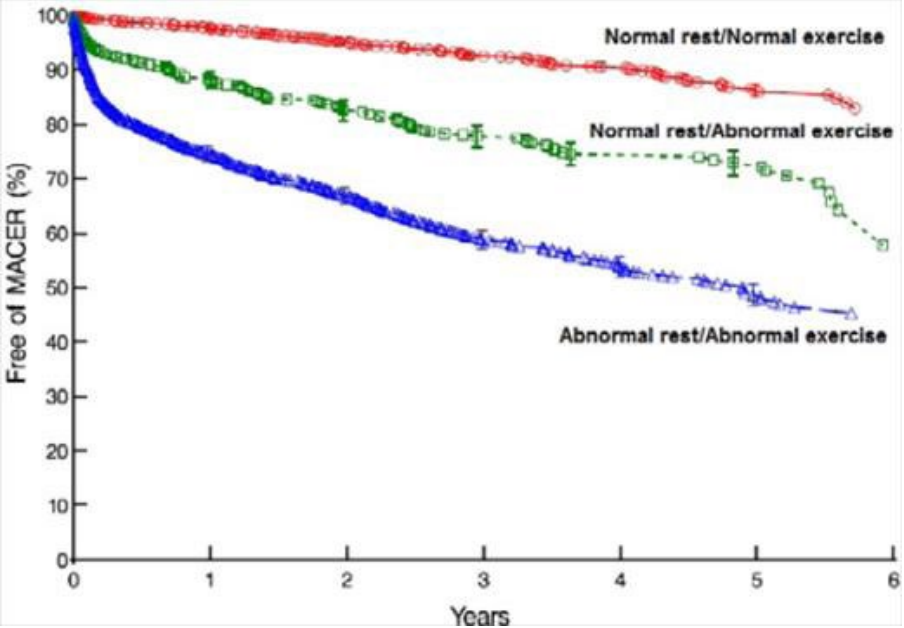

Right
Femoral
Sup. femoral
Popliteal
Posterior tibial
Dorsalis pedis
Doppler waveforms
1 sec/div
99
157
105
150
109
157
PT 98
DT 92
PT 151
DT 111
88
114
149 | Brachial | 144
Indexes
0.66 | U. thigh | 1.05
0.70 | L. thigh | 1.01
0.73 | Calf | 1.05
0.66 | Ankle-PT | 1.01
0.62 | Ankle-DP | 0.74
0.59 | Toe | 0.77
Left
Femoral
Sup. femoral
Popliteal
Posterior tibial
Dorsalis pedis

B

Exercise Testing

- Useful adjunct in patients with claudication symptoms and normal resting ABI's.
- Can differentiate claudication from 'pseudoclaudication'
- Requires walking 2 mph at a 12° incline for 5 minutes, or performing 50 consecutive toe raises.
- A drop in the SBP of > 20 mmHg indicates the presence of hemodynamically significant disease.

Exercise Testing



Duplex Ultrasound

•First described in the 1880's by the Curie brothers, who were able to produce electricity by mechanically vibrating a quartz crystal – the piezoelectric effect.

•In 1958 Brown developed a two dimensional scanner that allowed for visualization of tissue density.

•'Brightness mode' and 'Gray scale' modalities were developed over the next twenty years, leading to real time imaging capabilities

Duplex Ultrasound

- Consists of real time B mode/Gray scale imaging and color pulsed wave doppler ultrasound.
- Provides both anatomic and functional assessment of the vessel.
- B-mode imaging allows for visual resolution of the arterial wall, and characterization of atherosclerotic plaque.
- Pulsed-wave color doppler measures flow velocities and blood flow patterns.

Technical limitations

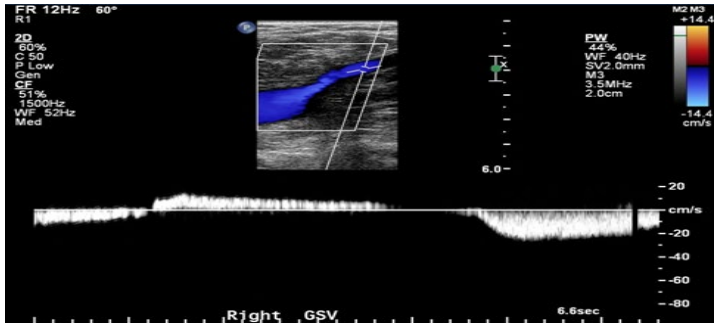
Technical limitations

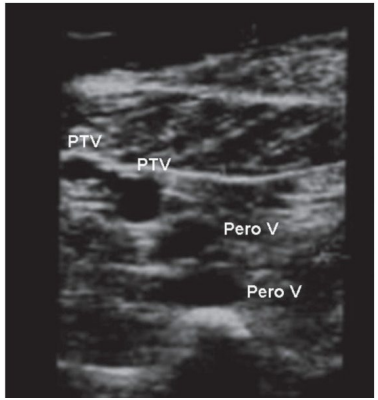
Technical limitations

Raynaud's Syndrome

PVL Venous to R/O DVT

- Unilateral or Bilateral; all unilateral include contralateral CFV
- Common Femoral through named calf veins
- **DVT aging** (acute, chronic, age indeterminate)
- Assess for **Proximal Venous Obstruction**
- **Reflux** GSV SFJ, Deep veins
- DVT is what we evaluate for; it **IS NOT** the indicator for the exam unless there is KNOWN DVT. Examples of accepted indicators: SOB, PE, edema, pain or trauma.





Arterial graft surveillance

Duplex scan surveillance during the first year after infrainguinal autologous vein bypass grafting surgery: Costs and clinical outcomes compared with other surveillance programs.

… in patients treated for critical limb ischemia, duplex scan surveillance was the least expensive ($2974) and resulted in the fewest major amputations (19 per 1000 patients).

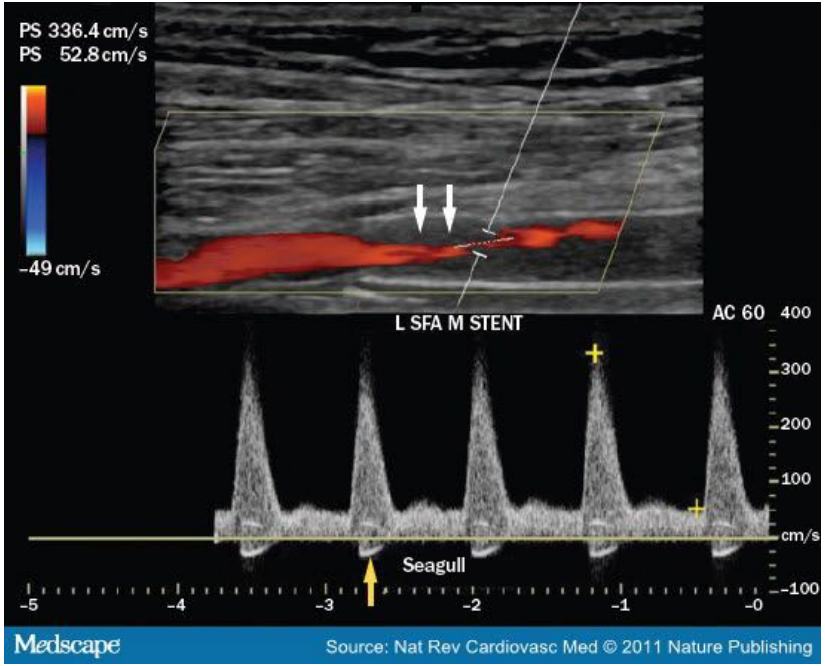
Visser, et al, JVS 2001

Is duplex surveillance of value after leg vein bypass grafting? Principal results of the Vein Graft Surveillance Randomised Trial (VGST).

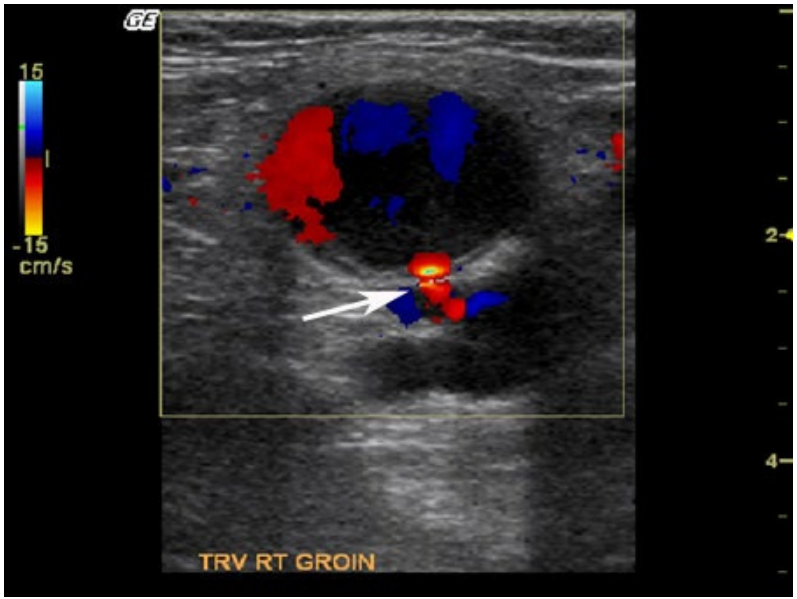
Intensive surveillance with duplex scanning did not show any additional benefit in terms of limb salvage rates for patients undergoing vein bypass graft operations, but it did incur additional costs.

Davies, et al, Circulation 2005

Bypass graft surveillance



Treatment of arterial pseudoaneurysms



Duplex Directed Thrombin injection - DDTI

•240 patients with either a brachial or femoral artery pseudoaneurysm following percutaneous catheterization.

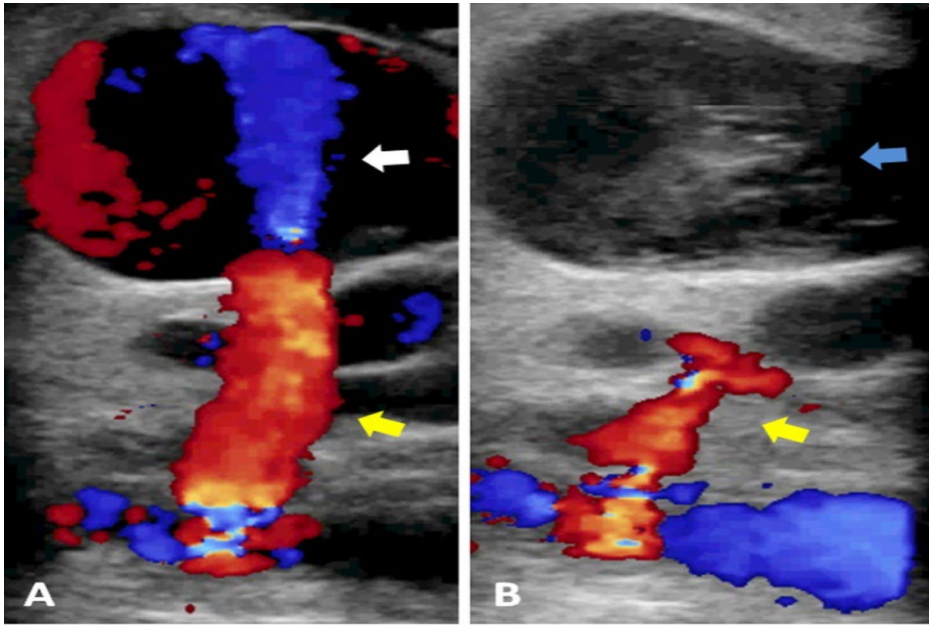
•Lyophilized bovine thrombin reconstituted with sterile water to a concentration of 1000 IU per 1.0 ml. Injected in 0.1 ml aliquots under ultrasound guidance.
•Average volume of 3 – 400 IU used per injection.

•Primary and secondary success rates of 95.8 and 99,6%, respectively.

•No major complications reported.
•Most common complaints were of mild to moderate pain at the injection site, and low grade temperature.
•No reported recurrences, though follow-up was short (21 days)

Krueger, et al JR, 2005

Treatment of arterial pseudoaneurysms



AV graft assessment

AV graft assessment

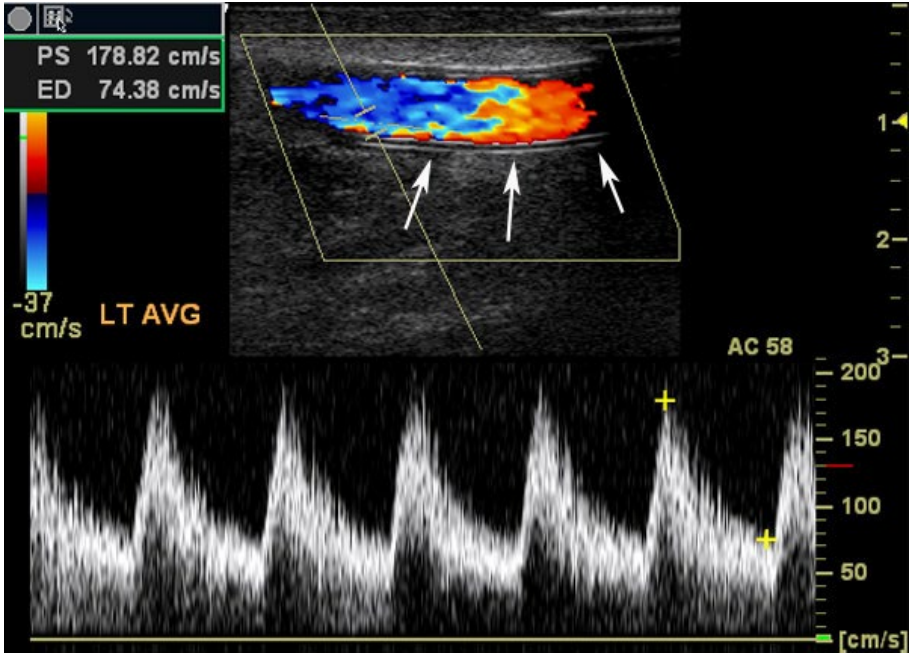
•Arterial and venous stenoses, graft thrombosis (occlusive and nonocclusive), infection, aneurysm and pseudoaneurysm formation, and arterial steal are relatively common abnormalities.

•Sonographic evaluation at the time of initial dysfunction may reveal an underlying correctable abnormality, and specific therapy may be instituted before the condition progresses.

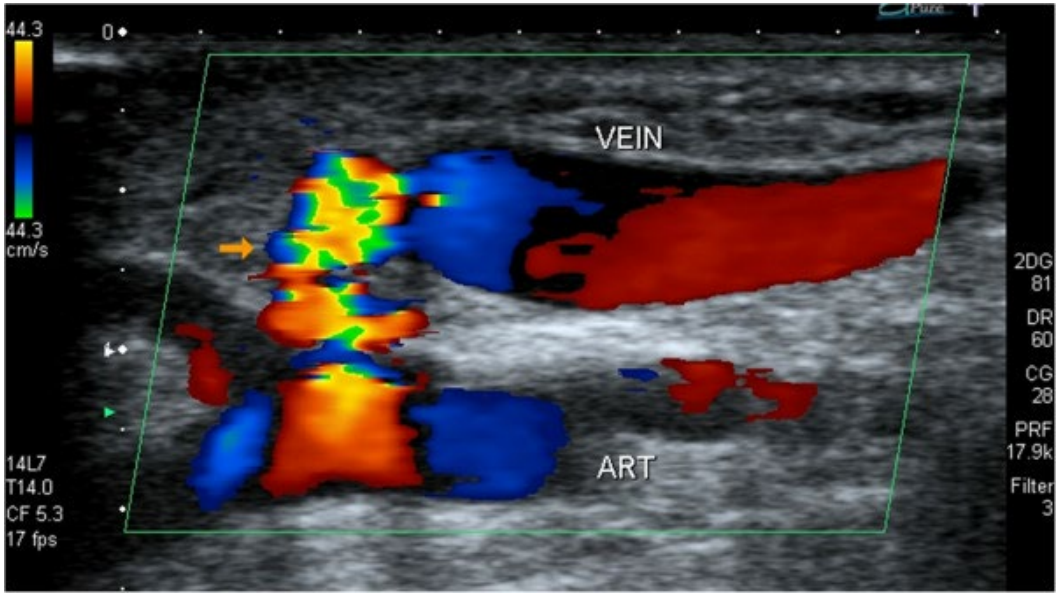
• Sonography may obviate an invasive angiographic examination if no significant hemodynamic problem is present.

Finlay, et al Radiography 1993

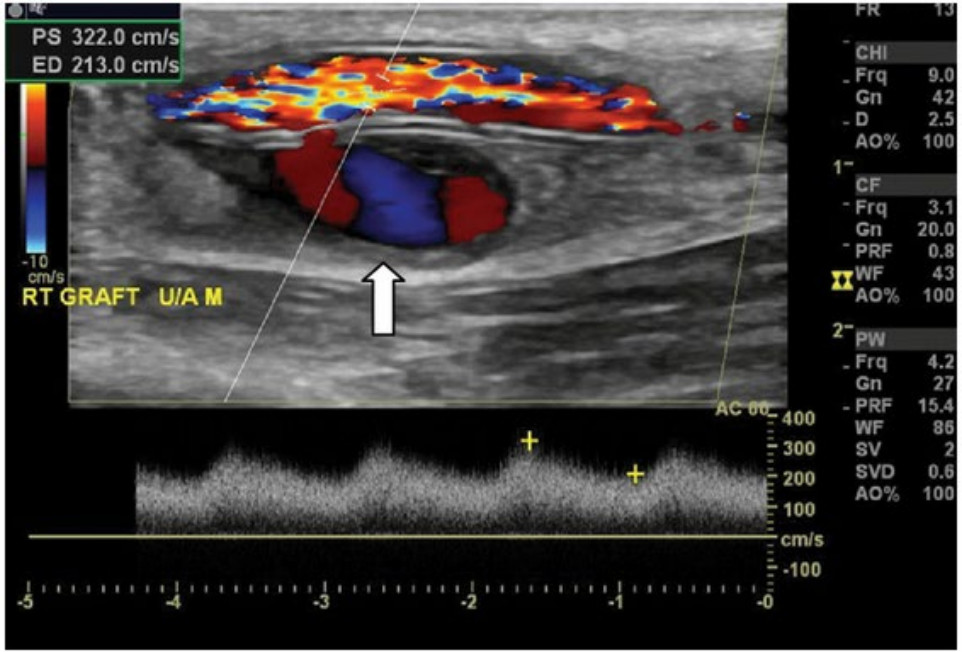
AV graft assessment



AV graft assessment



AV graft assessment



Temporal arteritis

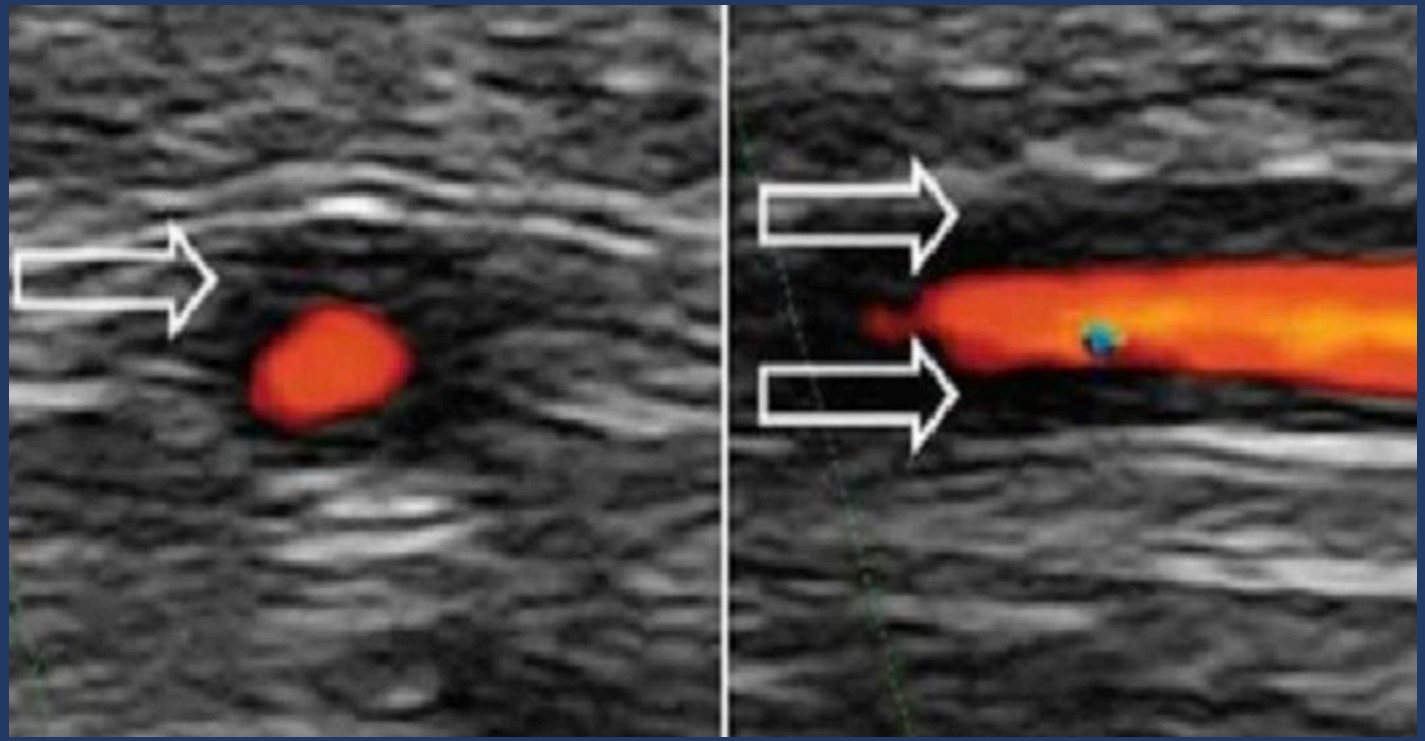
The utility of color duplex ultrasonography in the diagnosis of temporal arteritis

Christopher J LeSar [1], George H Meier, Richard J DeMasi, Jaideep Sood, Courtney R Nelms, Kathleen A Carter, Robert G Gayle, F Noel Parent, Michael J Marcinczyk

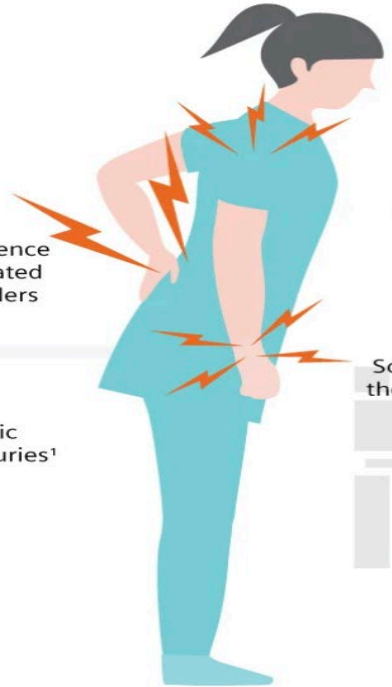
”… When CDU examined for halo alone as the determinate for disease, the sensitivity, specificity, PPV and NPV, compared to histologic confirmation of TA, were 85.7%, 92.0%, 75.0%, and 95.8%, respectively.”

JVS, 2002

Temporal arteritis ‘Halo sign’



Sonographers Are in Pain



90%
of sonographers experience symptoms of Work-Related Musculoskeletal Disorders (WRMSDs)[1]

20%
of those symptomatic suffer career-ending injuries[1]

$771,500
Direct and indirect cost to employer per injured sonographer[2]

39%
Sonographers report patient obesity as the most significant barrier to practicing ergonomic scanning techniques[3]

The impact of the development of a program to reduce urgent (off-hours) venous duplex ultrasound scan studies

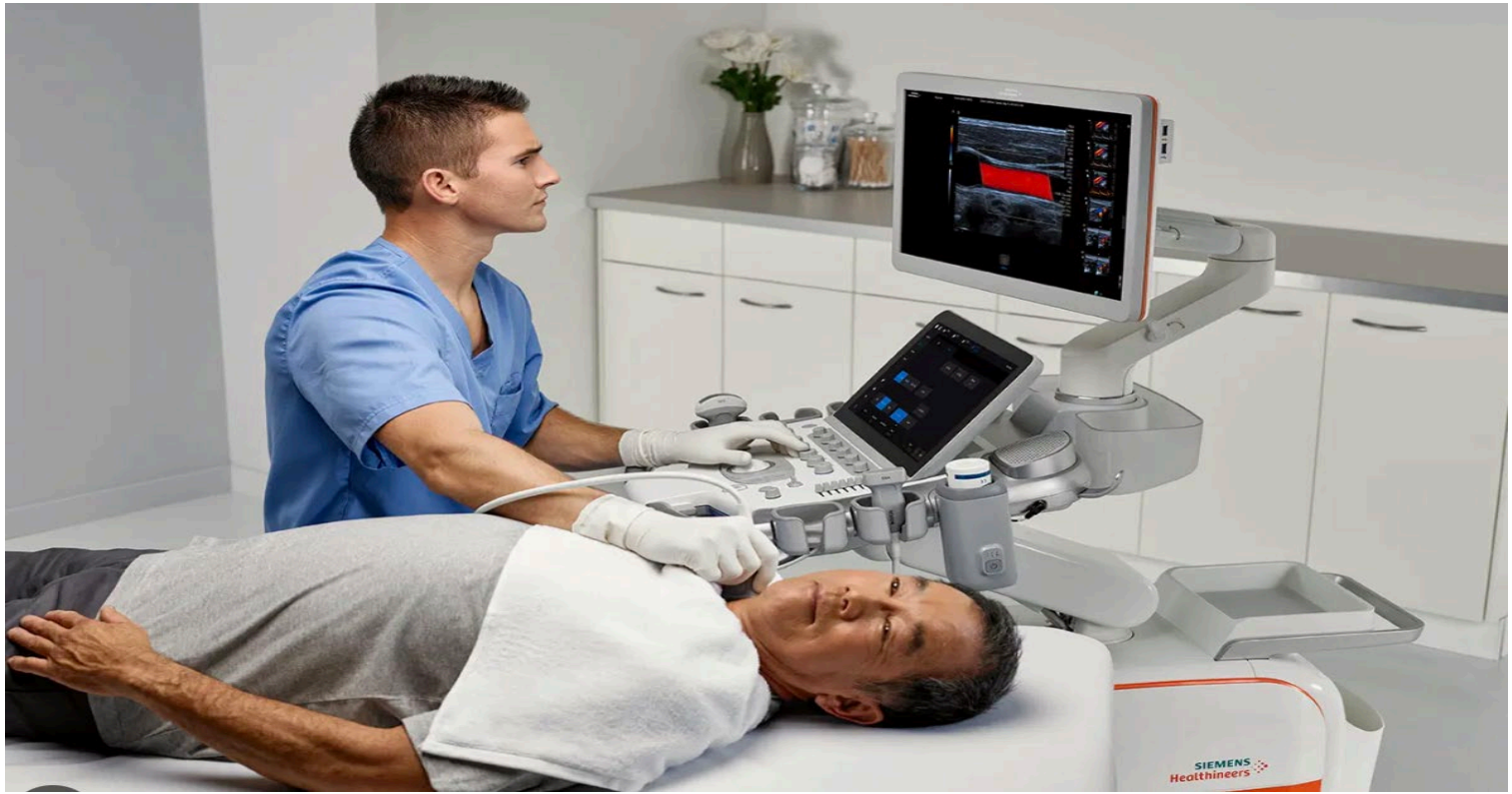
Eugene M. Langan III, MD, Cindy B. Coffey, RVT, Spence M. Taylor, MD, Bruce A. Snyder, MD, Timothy M. Sullivan, MD, David L. Cull, MD, Jerry R. Youkey, MD, and **Bruce H. Gray, DO,**
Greenville, SC

- ***Conclusion:*** **The development of the LMWH program has reduced after-hours VDUs by 89% without causing patient morbidity or mortality.**

Retention of RVTs has been 100% since program implementation.

J Vasc Surg 2002;36:132-6

PVL is a service line




PVL
NOW YOU CAN GET POINTS TOWARD
FREE PIZZA
ANY WAY YOU ORDER
VASCULAR
We Go With The Flow

Conclusions

Non-invasive arterial imaging of the extremities is:

1. Cost effective.
2. Low risk
3. Provides functional assessment in addition to high quality imaging.
4. Has few technical limitations
5. Patient and Technician dependent


SENTARA