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Venous Ultrasound 1 – Lower Extremity Venous insufficiency, and Ultrasound in Office Based Venous Procedures

Harvard Ultrasound Course June 2021

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No Disclosures

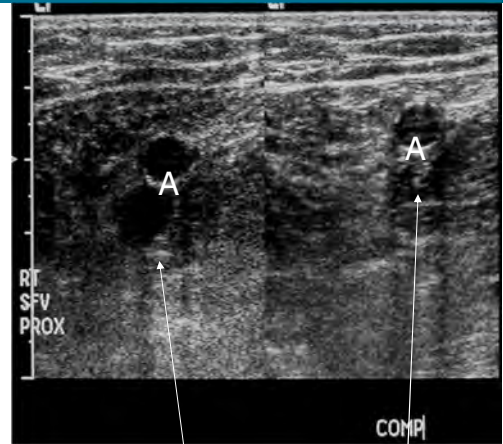


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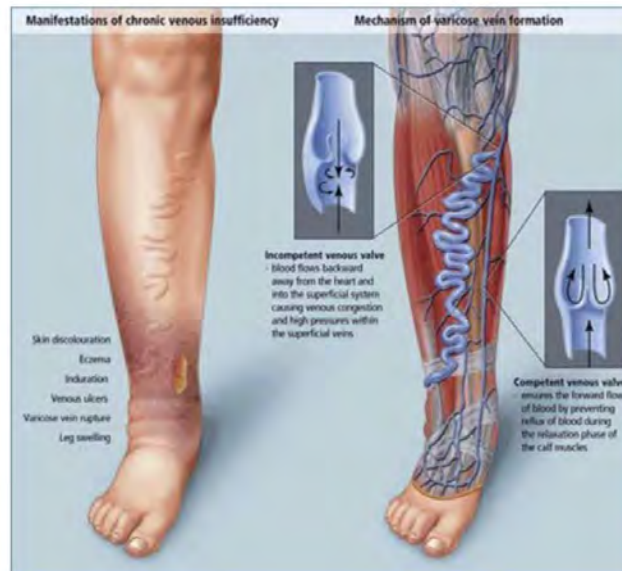
Uses of Ultrasound

- Evaluate for patency, size, flow, wall characteristics
- Evaluate anatomy quickly and easily
- Examination of structures with a lumen
- Evaluate for solid v. cystic
- Guidance for percutaneous drainage, venous ablation techniques, insertion of lines, etc



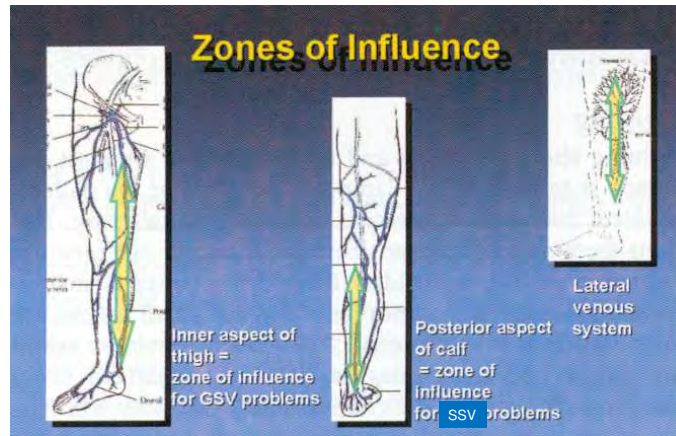
Artery and Vein without compression, and patent/ normal vein with compression

Vascular Laboratory is the first step toward solving the Puzzle...

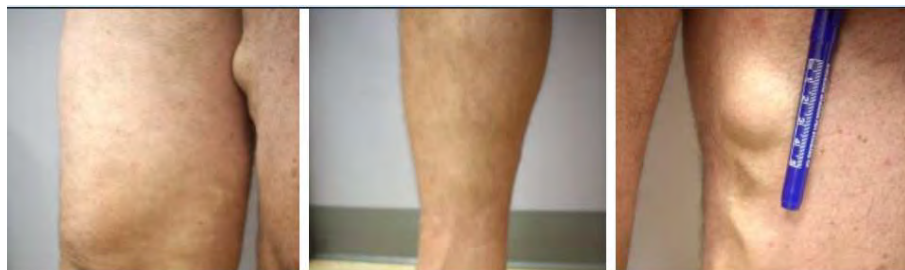


Examiner Must Understand: Venous Anatomy and Physiology

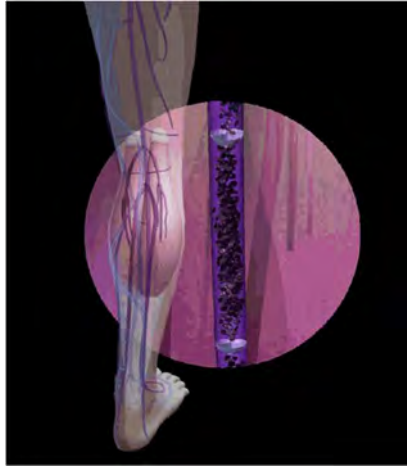
- Anatomy
 - Deep
 - Superficial
 - Perforators
- Physiology
 - Calf muscle pump
 - Valves
- Pathophysiology



TIP: Prior to the exam, Stand the patient up



Musculovenous pump



- Foot and calf muscles act to squeeze the blood out of the deep veins
- One way valves allow only upward and inward flow
- During muscle relaxation, blood is drawn inward through perforating veins
- Superficial veins act as collecting chamber

Illustration by Linda S. Nye

Copyright © 2009 by American College of Phlebology

Physical Examination BEFORE you scan

- Inspect the medial and lateral malleolar areas for: skin changes suggestive of chronic venous insufficiency, corona phlebectasia, ulcers
- Examine feet for edema (stemmer's sign on toes)
- Assess for pitting edema bilaterally
- Assess the areas of concern (varicosities, spider veins, painful areas, etc)
- Recognize the zones of influence

Great Saphenous Insufficiency



- Skin changes are seen along the medial aspect of the ankle
- The presence of skin changes is a predictor of future ulceration*

*Kirsner R et al. The Clinical Spectrum of Lipodermato-sclerosis, J Am Acad Derm, April 1993;26(4):623-7

Duplicate Saphenous Venous Tributaries

**Anterior Thigh Circumflex
Or Anterior Accessory GSV**



**Posterior Thigh Circumflex
Or Pudendal Or Posterior GSV**



Varicose Veins – Small Saphenous Distribution



- Less frequent than Great Saphenous involvement
- Varicosities may be seen on the posterior calf and more often the lateral ankle
- Skin changes are seen along the lateral ankle



C1 Lateral Subdermic Plexus



- Very common, especially in women
- Superficial veins with direct perforators to deep system
- Remnant of embryonic deep venous system
- Commonly enlarged in Venous Anomalies like Klippel Trenaunay Syndrome (check deep system!)

CEAP Classification/ Stages

“C” = Clinical

C0 - no visible venous disease

C1 - telangiectasias or reticular veins

C2 - varicose veins

C3 - edema

C4 - skin changes without ulceration

C4a – pigmentation or eczema

C4b – LDS or atrophie blanche

C5 - skin changes with healed ulceration

C6 - skin changes with active ulceration

“E” = Etiology (primary vs. secondary)

“A” = Anatomy (defines location of disease within

superficial, deep and perforating venous systems)

“P” = Pathophysiology (reflux, obstruction, or both)

C1:Telangiectasias



- Also known as “spider veins” due to their appearance
- Very common, especially in women, hereditary
- Increase in frequency with age
- 85% of patients are symptomatic*
- May indicate more extensive venous disease when around ankles

*Weiss RA and Weiss MA *J Dermatol Surg Oncol.*
1990 Apr;16(4):333-6.

C1 Reticular Veins



- Enlarged, greenish-blue appearing veins
- Frequently associated with clusters of telangiectasias
- May be symptomatic, especially in dependent areas of leg

Ultrasound for C1 veins

Typically Vein light transillumination is used rather than ultrasound...



C2: Varicose Veins –



- Most common finding in patients with varicose veins
- Varicosities most commonly along the medial thigh and calf but cannot assume location indicates origin
- At least 20% of patients are at risk of ulceration

C3 Varicose Veins and Leg Edema



C4-5 Skin changes suggestive of chronic venous insufficiency



Corona Phlebectatica (C1)



Atrophie blanche



Pigmentation (C4a)



Healed ulcer (C5)

19

C5-6 Advanced CVI

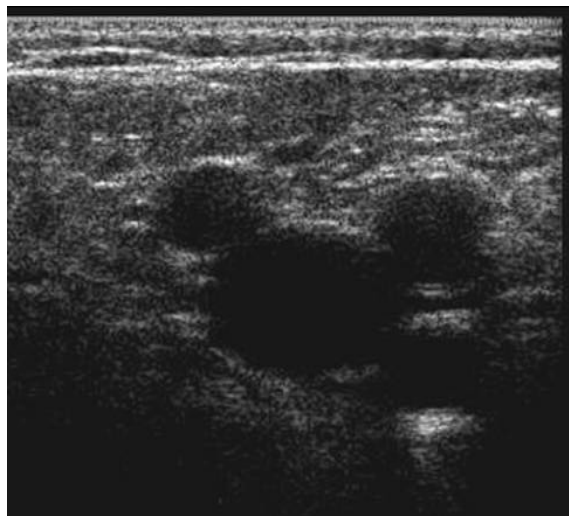


Healed Ulcerations
(C5)



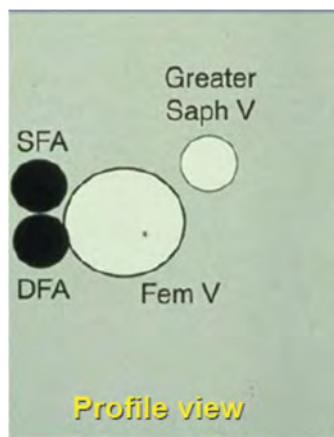
Open Ulcerations
(C6)

Basic Anatomy of Lower Extremity Veins



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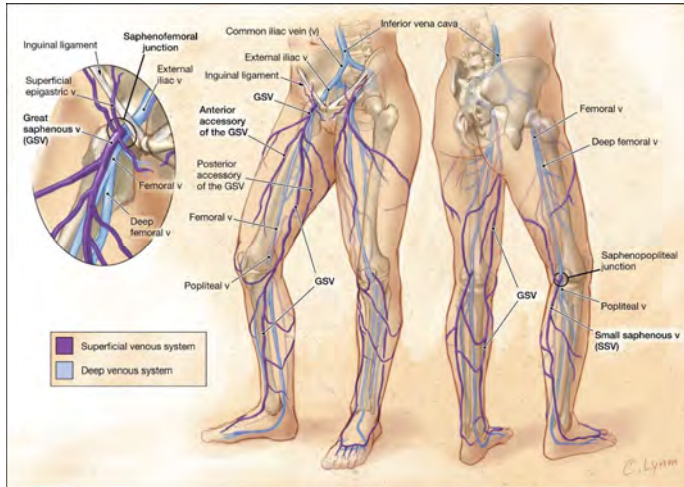
Duplex – Mickey Mouse views of saphenofemoral junction (SFJ)



Courtesy of J. Zygmunt, Jr, RVT

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Lower Extremity Venous Drainage

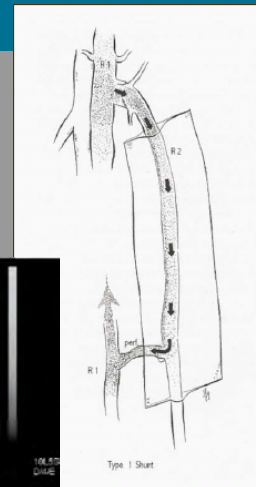
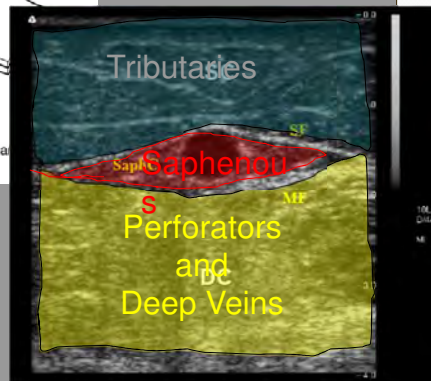
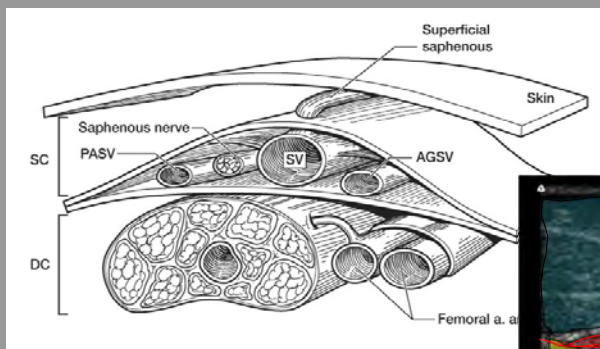


Four Venous Networks

- Superficial venous compartment
- Saphenous venous compartment
- Perforators
- Deep venous compartment

Principles of Venous Hemodynamics Nova Science Publishers
 Claude Franceschi, M.D. Paolo Zamboni, M.D.

TIP: Find the Fascia!

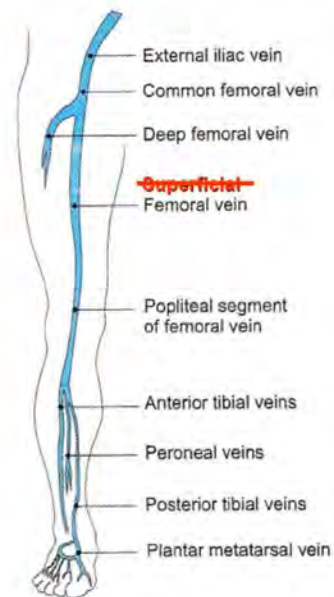


Deep Veins

- 5 named branches:
 - 2 thigh, 3 calf
- Accompanied by an artery
- Carries >90% of blood out of the leg

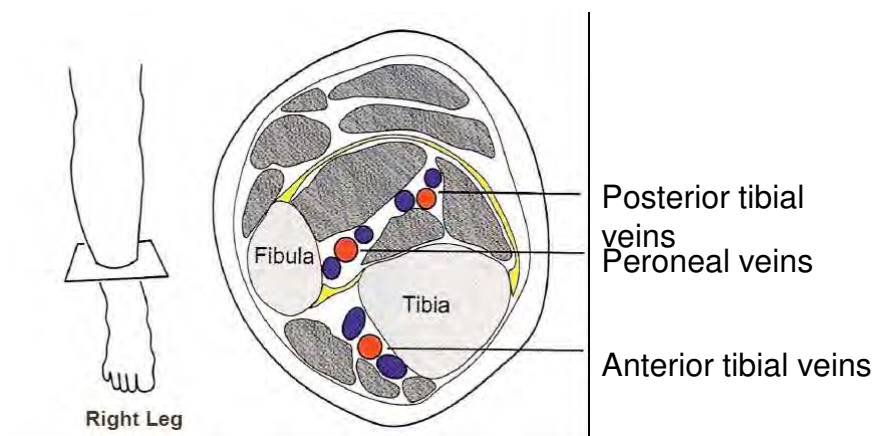
Bundens WP, Bergan JJ.

The superficial femoral vein:
A potentially lethal misnomer
JAMA; 274:1296-98, 1995.



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Deep Veins of the calf

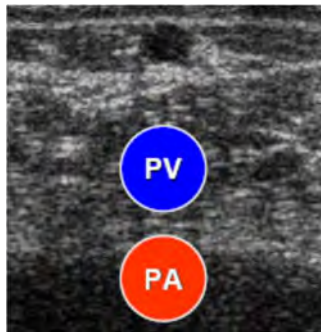


Vein diagnosis & treatment. Weiss et al. modified

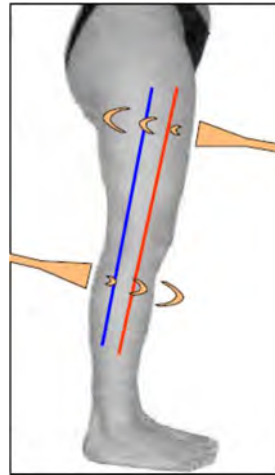
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Transposition of the probe not the deep vessels

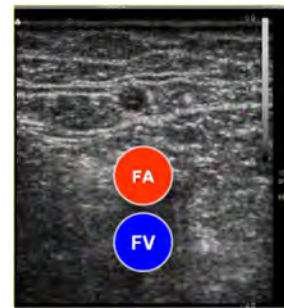
Popliteal Fossa



Popliteal vein superficial



Medial Thigh



Femoral artery superficial

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Nomenclature of the deep veins

THIGH

Common femoral vein
Femoral vein
 Deep femoral vein
 Deep femoral communicating veins
 (accompanying veins of perforating arteries)
 Medial circumflex femoral vein
 Lateral circumflex femoral vein
 Sciatic vein

KNEE

Popliteal vein
 Genicular venous plexus

LEG

Sural veins
 Soleal veins
 Gastrocnemius veins
 Medial gastrocnemius veins
 Lateral gastrocnemius veins
 Intergemellar vein
 Anterior tibial veins
 Posterior tibial veins
 Fibular or peroneal veins

FOOT

Medial plantar veins
 Lateral plantar veins
 Deep plantar venous arch
 Deep metatarsal veins (plantar and dorsal)
 Deep digital

Superficial Venous System

Variable network of interconnecting and communicating veins within the superficial compartment (includes Saphenous compartment)

Anatomy is extremely variable compared to DVS and is not accompanied by an artery

Divided into three systems:

- Great Saphenous
- Small Saphenous
- Lateral



Nomenclature of the superficial veins

Great saphenous vein

Sapheno-femoral Junction
Terminal valve
Preterminal Valve
External pudendal vein
Superficial circumflex iliac vein
Superficial epigastric vein
Superficial dorsal vein of clitoris or penis
Anterior labial veins
Anterior scrotal veins
Anterior accessory of the great saphenous vein
Posterior accessory of the great saphenous vein
Superficial accessory of the great saphenous vein

Caggiatti A, et al. J Vasc Surg 2005;41:719-24.
Caggiatti A, et al. J Vasc Surg 2002;36:416-22

Small saphenous vein

Sapheno-popliteal junction
Cranial extension of the small saphenous vein (*Giacomini vein)
Superficial accessory of the small saphenous vein
Anterior thigh circumflex vein
Posterior thigh circumflex vein
Intersaphenous veins
Lateral venous system
Dorsal venous network of the foot
Dorsal venous arch of the foot
Superficial metatarsal veins (dorsal and plantar)
Plantar venous subcutaneous network
Superficial digital veins (dorsal and plantar)
Lateral marginal vein
Medial marginal vein

Nomenclature of the perforating veins

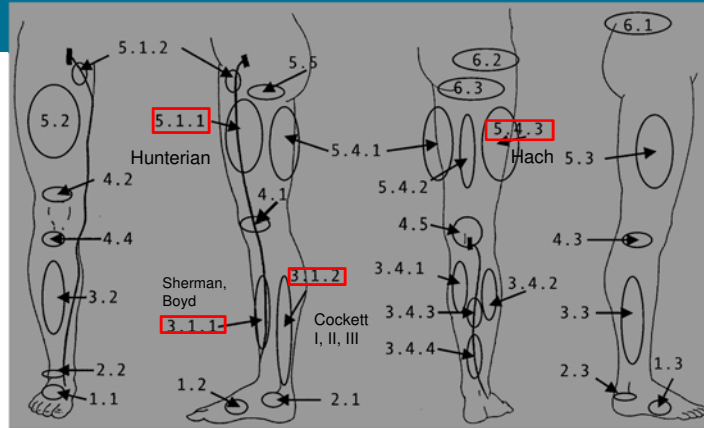
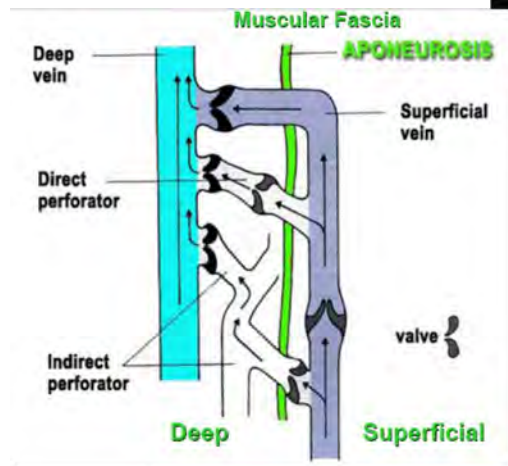


Fig 5. Schematic representation of the topography of the main groups of perforating veins (PVs). Foot PVs: 1.1, dorsal foot PV; 1.2, medial foot PV; 1.3, lateral foot PV. Ankle PVs: 2.1, medial ankle PV; 2.2, anterior ankle PV; 2.3, lateral ankle PV. Leg PVs: 3.1.1, paratibial PV; 3.1.2, posterior tibial PV; 3.2, anterior leg PV; 3.3, lateral leg PV; 3.4.1, medial gastrocnemius PV; 3.4.2, lateral gastrocnemius PV; 3.4.3, intergemellar PV; 3.4.4, para-achilleal PV. Knee PVs: 4.1, medial knee PV; 4.2, suprapatellar PV; 4.3, lateral knee PV; 4.4, infrapatellar PV; 4.5, popliteal fossa PV. Thigh PVs: 5.1.1, PV of the femoral canal; 5.1.2, inguinal PV; 5.2, anterior thigh PV; 5.3, lateral thigh PV; 5.4.1, posteromedial thigh PV; 5.4.2, sciatic PV; 5.4.3, posterolateral thigh PV; 5.5, pudendal PV. Gluteal PVs: 6.1, superior gluteal PV; 6.2, midgluteal PV; 6.3, lower gluteal PV.

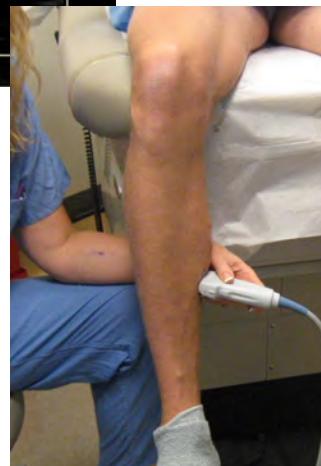
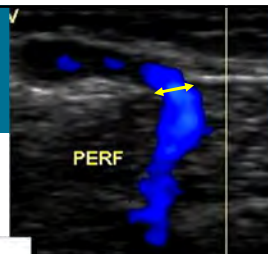
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Caggiatti A, et al. J Vasc Surg 2002;36:416-22.

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Perforators

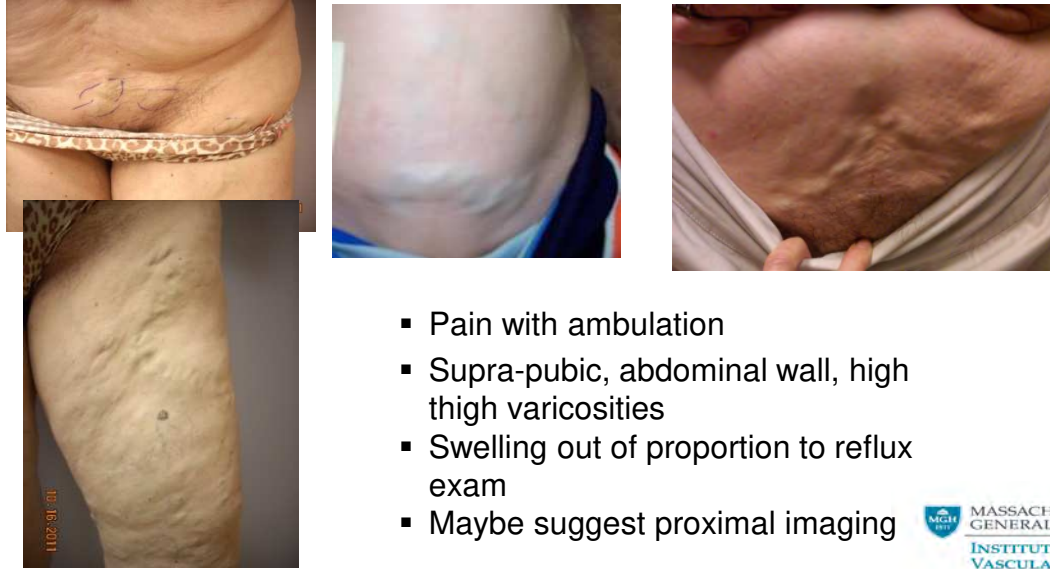


JF Uhl, MD



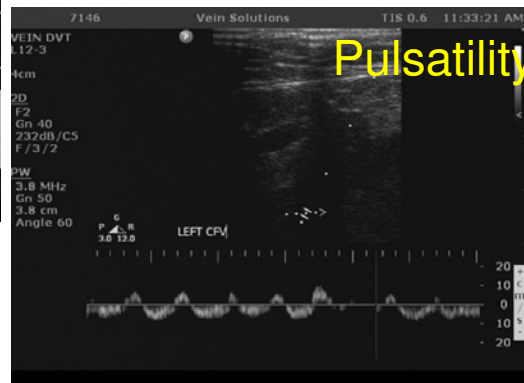
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Look for signs of Pelvic Vein Obstruction

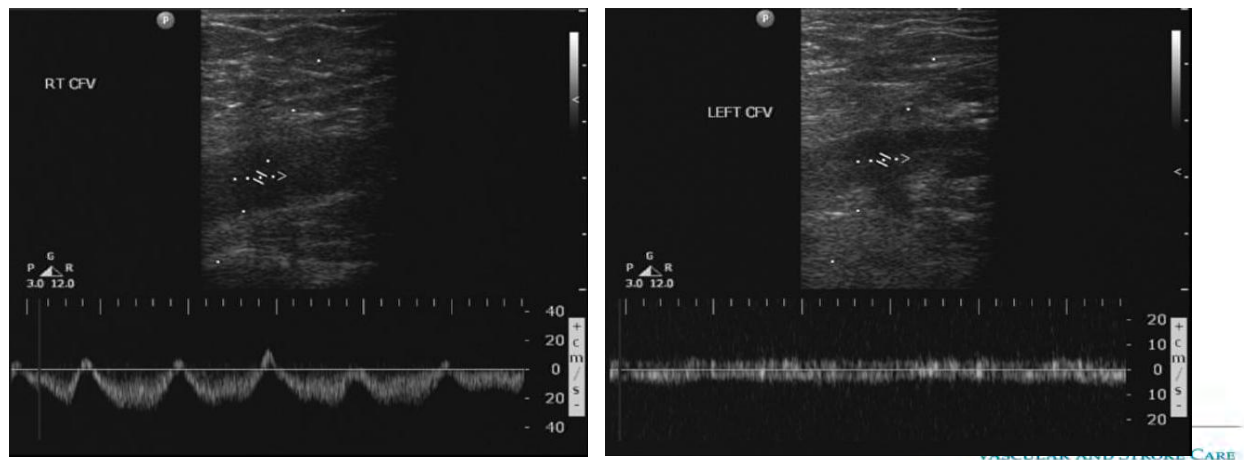


- Pain with ambulation
- Supra-pubic, abdominal wall, high thigh varicosities
- Swelling out of proportion to reflux exam
- Maybe suggest proximal imaging

Doppler Waveform Analysis of BOTH groins



Proximal Iliac Venous Obstruction



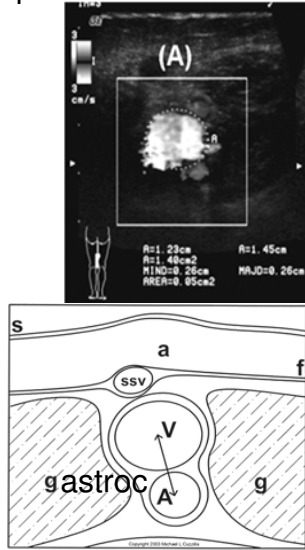
Assess for Popliteal Vein Compression

- Stage of venous disease out of proportion to reflux
- Common in obese individuals
- May need decompression
- Ultrasound in standing position with knee slightly flexed/ non-weight bearing, then with knee straight (locked)
- Popliteal vein diameter will diminish with knee straight position

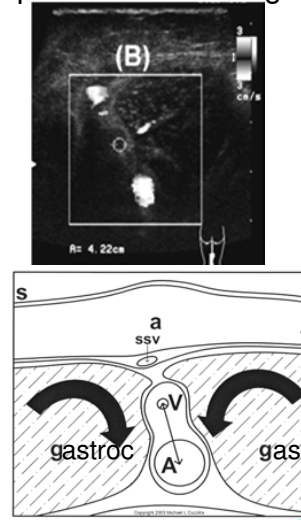
Popliteal Vein Compression Syndrome

Lane RJ, et al. *Phlebology* 2009;24:201-207

Pop Vein Knee Bent



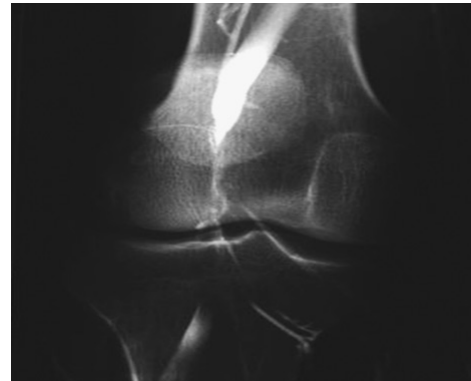
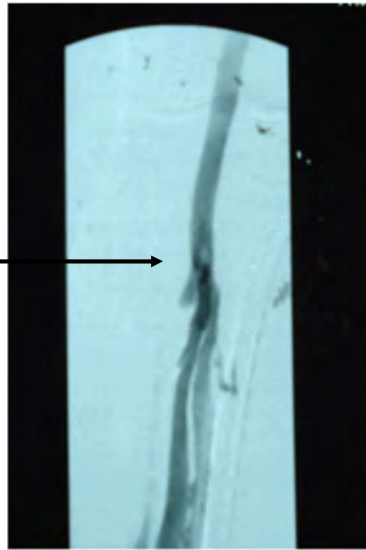
Pop Vein Knee Straight



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Position of leg is important

Normal in caliber
with leg slightly
bent



Popliteal Compression knee locked

Angeli AA et al. *JVS*, in press 2011

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General Terminology

- *Agenesis* indicates the complete absence of a vein or of a segment of a vein.
- *Aplasia* indicates the lack of development of a vein or of a segment of a vein. The vein is present but diminutive in size and its structure is similar to that in the embryo.
- *Hypoplasia* indicates the incomplete development of a vein or of a segment of a vein. It is less severe in degree than aplasia, and the hypoplastic vein has a reduced caliber with a normal structure

Proximal indicates closer to the heart
Distal indicates farther away from the heart

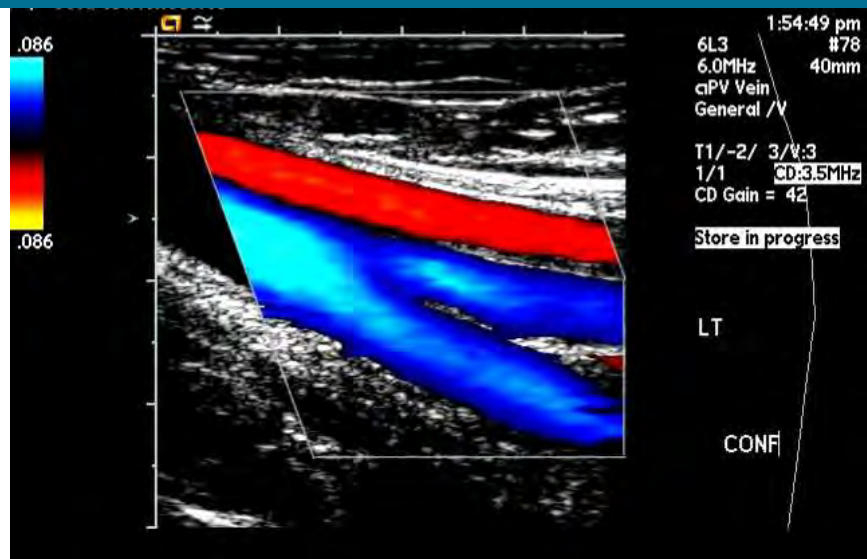
Caggiatti A, et al. *J Vasc Surg* 2005;41:719-24.
Caggiatti A, et al. *J Vasc Surg* 2002;36:416-22.

General Terminology

- *Dysplasia* indicates a complex abnormality of development of a vein or of a group of veins that greatly differs from the normal conditions in size, structure, and connections.
- *Atrophy* indicates a decrease in size or wasting away of a normally developed vein or segment of a vein, following a degenerative process. Wall changes are different, according to the nature of the degenerative process.
- *Venous aneurysm* indicates a localized dilation of a venous segment, with a caliber increase 50% compared with normal.
- *Venomegalia* designates diffuse dilation of one or more veins with a caliber increase 50% compared with normal.

Caggiatti A, et al. *J Vasc Surg* 2005;41:719-24.
Caggiatti A, et al. *J Vasc Surg* 2002;36:416-22.

Venous Confluence (not bifurcation)



Lower Extremity Deep Venous Compartment

Intermuscular

Femoral Vein of the thigh (formerly superficial femoral vein)

Deep Femoral

Popliteal

Tibial

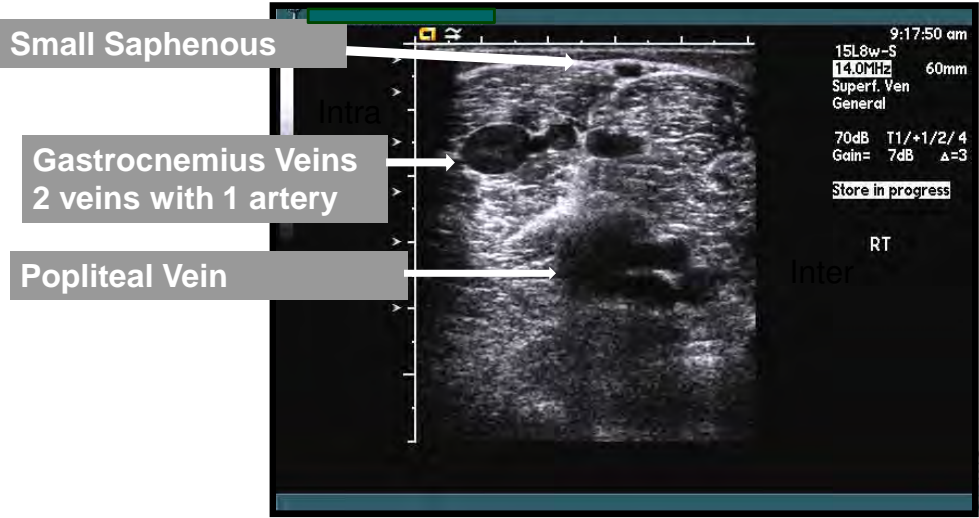
Peroneal

Intramuscular

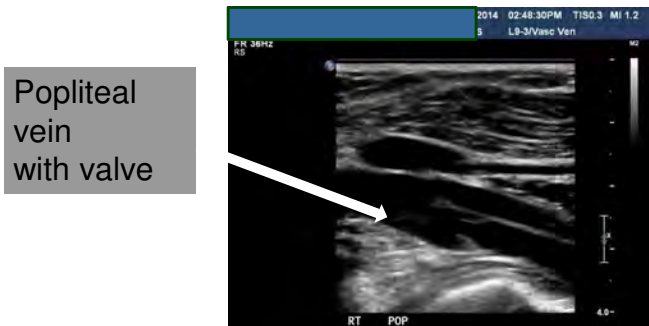
Gastrocnemius

Soleal

Intermuscular and Intramuscular Veins Lower Extremity Deep Veins



Popliteal Vein (longitudinal view) Lower Extremity Deep Veins



Veins within Saphenous Compartment

Great Saphenous Vein (GSV)

Anterior Accessory Great Saphenous Vein (AAGSV) – thigh or leg

Posterior Accessory Great Saphenous Vein (PAGSV) – thigh or leg

Small Saphenous Vein (SSV)

Thigh Extension/Giacomini Vein

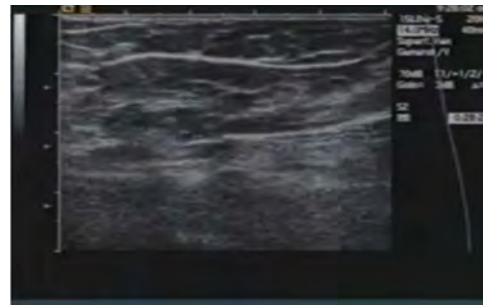
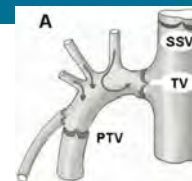
GSV Anatomy

Great Saphenous Vein – terminates at SFJ

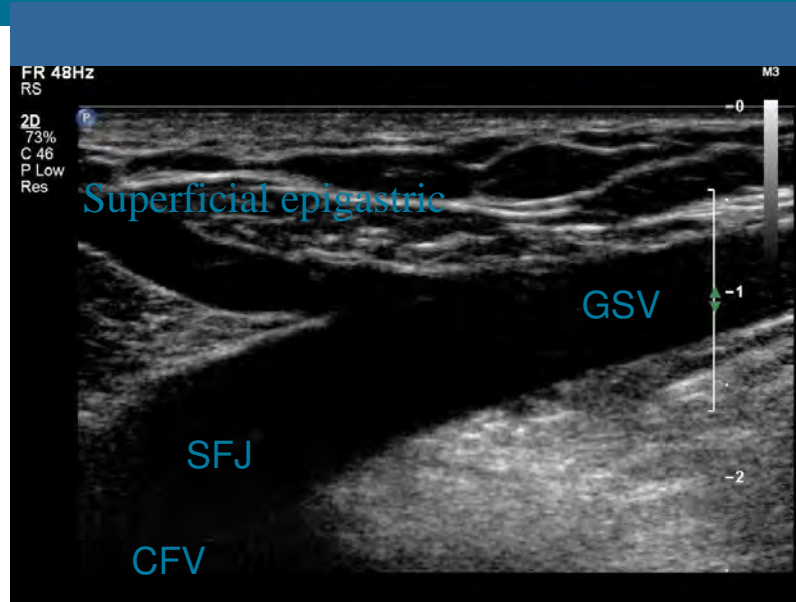
SFJ – includes GSV from terminal to pre-terminal valves

Most Important Tributaries of SFJ

- Superficial Epigastric
- Superficial Circumflex Iliac
- Superficial External Pudendal

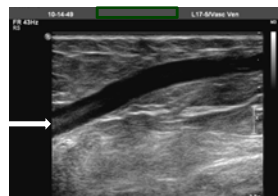
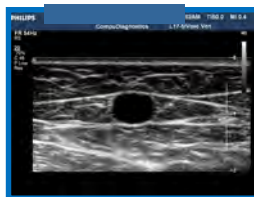


Saphenofemoral junction structures



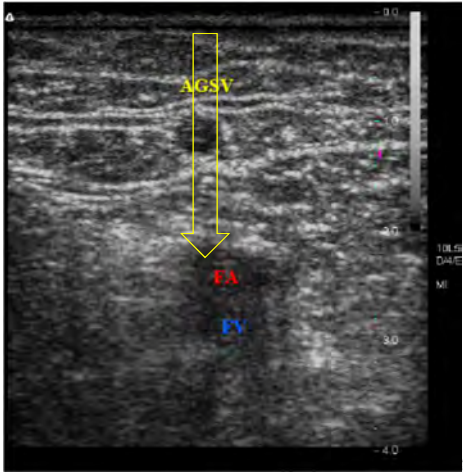
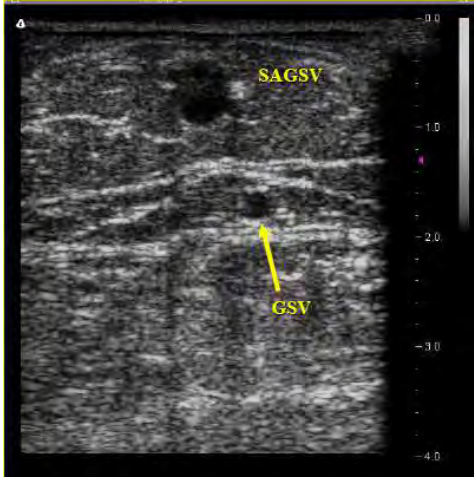
GSV Variations in Anatomy

GSV contained within the fascial compartment (saphenous) that comprises a well-defined deep layer that arises from the muscle fascia and lesser-defined superficial or saphenous fascial layer



Tributaries pierce the superficial layer of fascia to reach the GSV

Superficial Accessory GSV Anterior Accessory GSV



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Anterior accessory great saphenous vein alignment sign

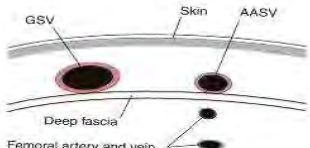
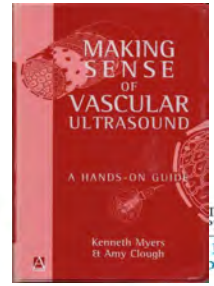


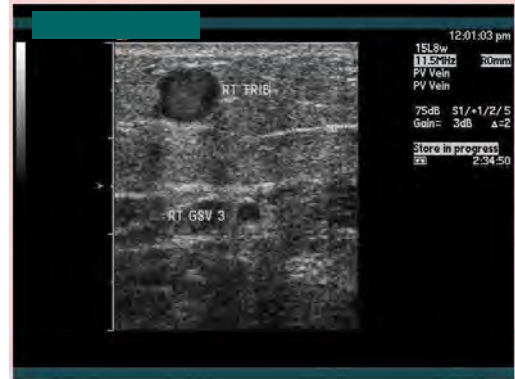
Fig. 10.15
Alignment sign in the left lower limb
The AASV lies superficial to the femoral artery and vein whereas the GSV is more medial.



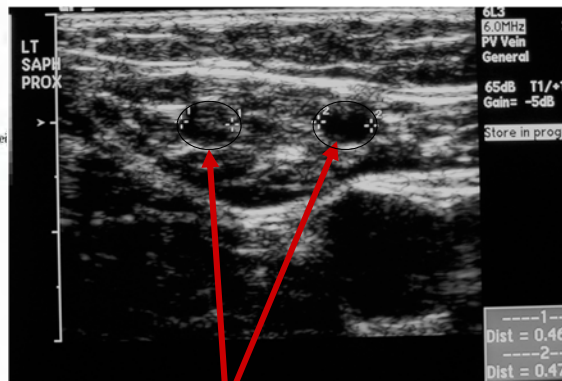
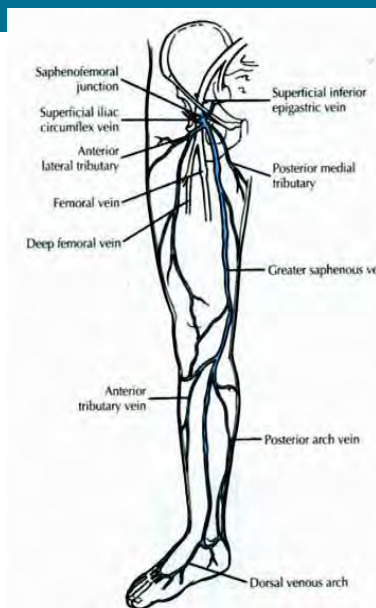
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Great Saphenous Vein

- Aplastic
- Hypoplastic
- Sonographically absent
 - ?previous treatment? i.e. stripping, EVTA, etc.

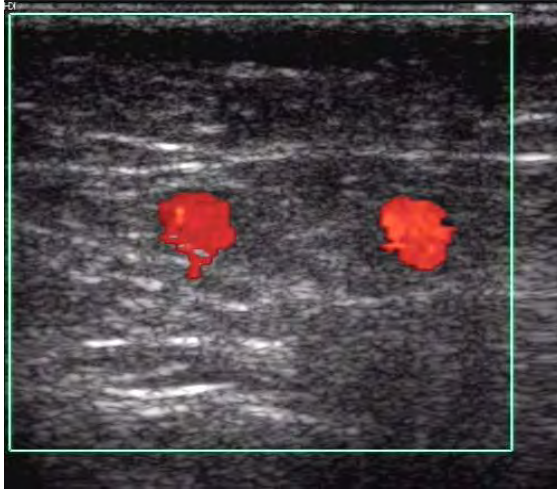


Greater Saphenous Anatomy



Dup GSV in fascia

Map out Reflux with Diagram: Duplicate GSV, Both with reflux



Anterior accessory great saphenous vein: Variations

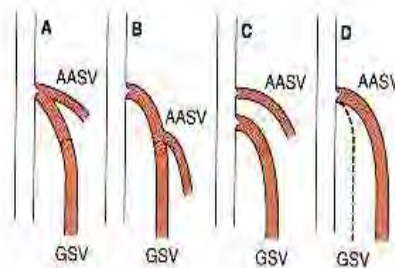


Fig. 10.4

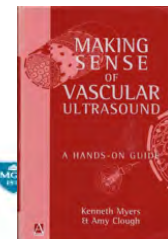
Variations in origin of the AASV

A: Common junction with GSV.

B: Origin from GSV below SFJ.

C: Origin from CFV above SFJ.

D: Origin from SFJ as principal vein with hypoplastic or absent GSV.



Small Saphenous Anatomy

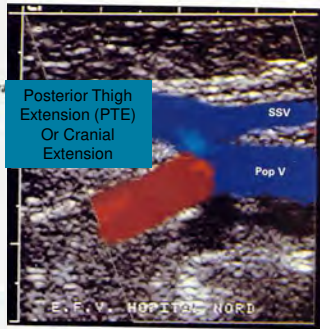
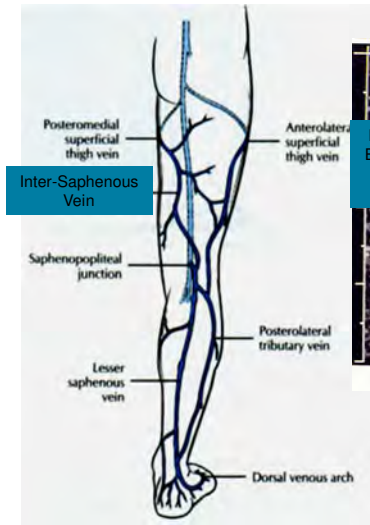
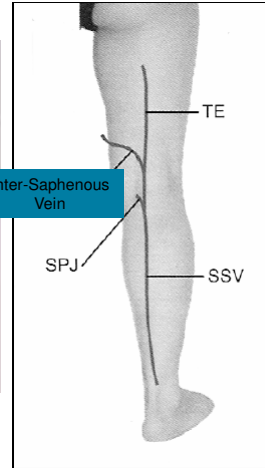
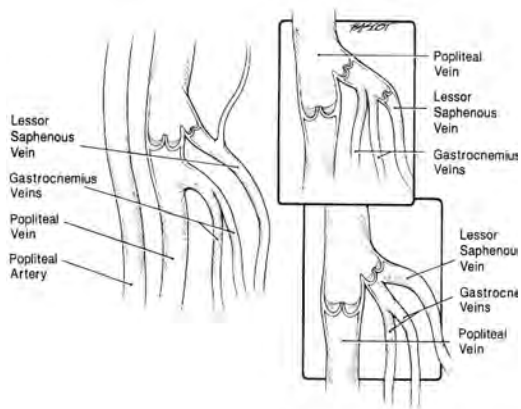


Fig. 4. - Popliteal junction of SSV and Glacomin's vein.



Variable Sapheno-Popliteal Junction Anatomy



Longitudinal View

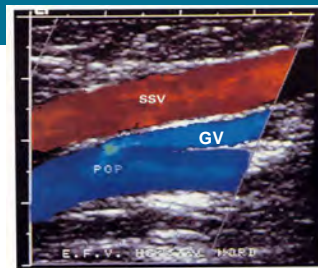


Fig. 7. - Reflux in the SSV with competent popliteal and medial gastrocnemius veins.

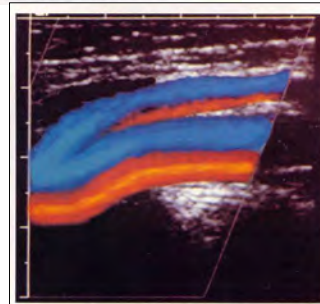
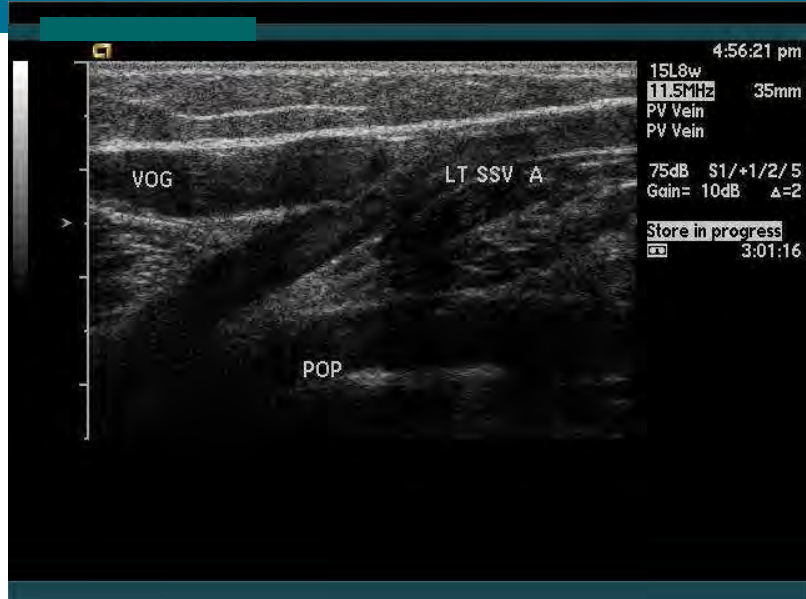


Fig. 2. - Medial gastrocnemius vein and artery at the level of the popliteal junction.

SPJ saphenopopliteal junction anatomy



Copyright 2005

SSV entering gastrocnemius veins into popliteal vein





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Lower Extremity Venous Testing Duplex Exam



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Deep Vein Evaluation: Standard DVT protocol

Evaluate for Bilateral Phasicity

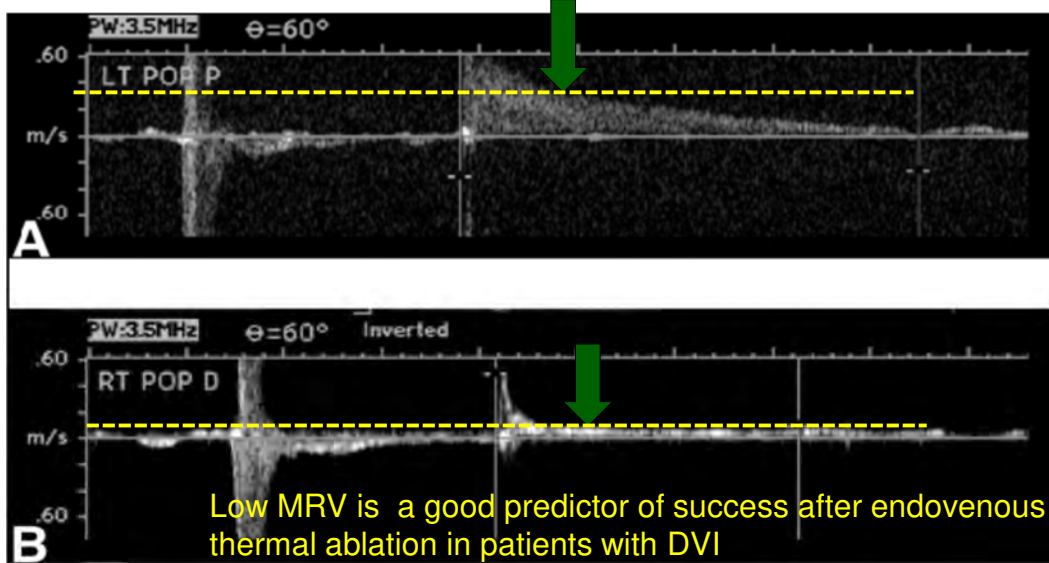
- Leg position: Knee flexed, leg externally rotated
- 15° reverse Trendelenberg
- Deep venous insufficiency with valsalva, augmentation release in the femoral, popliteal, and tibials



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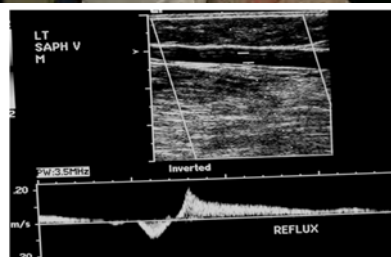
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Duplex Evaluation: Quantitative Deep Venous Insufficiency Maximum Reflux Velocity Measurement (MRV) *Marston et al, JVS 2008*

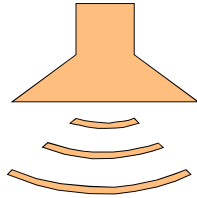


Venous Insufficiency Exam

- Assess for DVT or obstruction
- Doppler samples to determine reflux in deep veins, SFJ and multiple sites along the GSV, SSV and perforators
- Valsalva and augmentation is used when assessing for reflux.
- Reflux is noted as the reversal of flow after augmentation (usually 0.5-1.0 sec or greater)
- Doppler portion should be done in **standing position when assessing for reflux**



Scanning in the leg: TIP

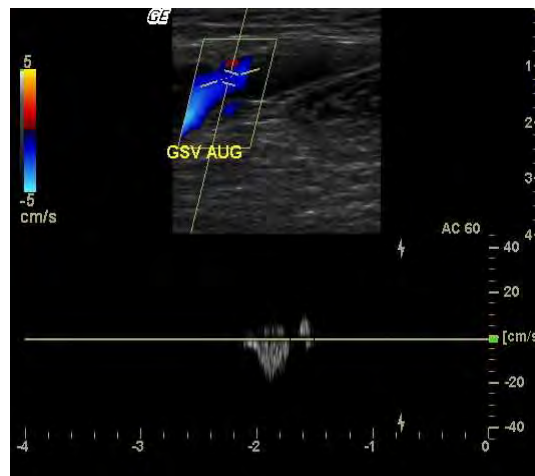


Superficial veins → Higher frequency (10-12 mHz)

Deeper veins → Lower frequency probe (3-5 mHz)

VASCULAR AND STROKE CARE

Venous Insufficiency Exam

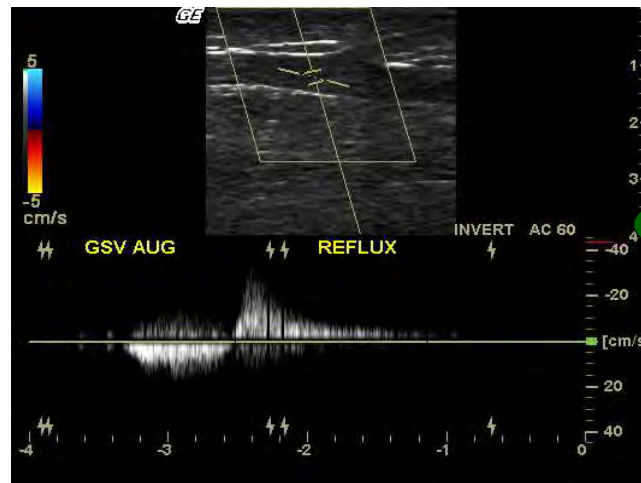


Valve Closure
Time <0.5

Normal valve closure time <0.5 sec

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Venous Insufficiency Exam



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SFJ GSV Reflux

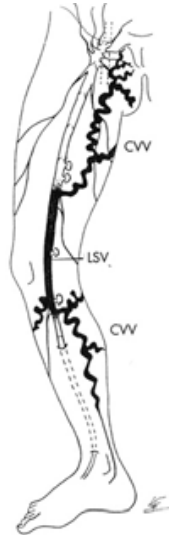
- 30% to thigh
- 40% to knee
- 30% to mid calf
- 1% to ankle



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Non-SFJ Sources of GSV Reflux

Pudendal Vein Reflux

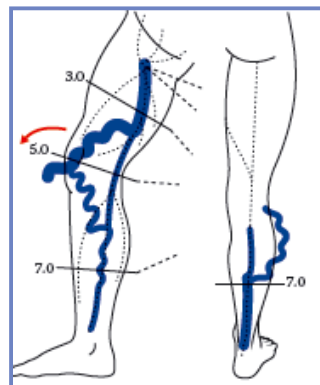
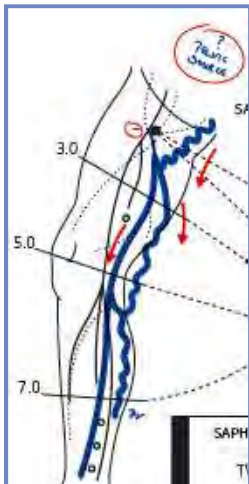


Perforator Vein Reflux



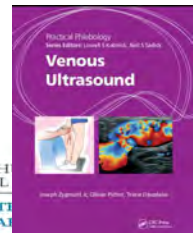
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Reflux Patterns Important

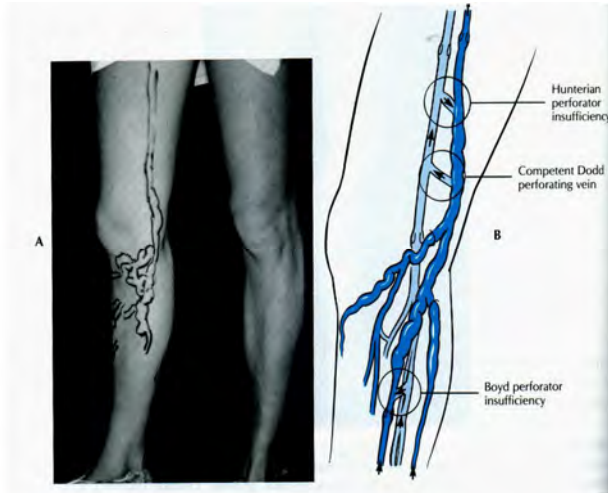


Zygmunt, J Pichot, O Dauplaise, T, **Practical Phlebology: Venous Ultrasound**, CRC

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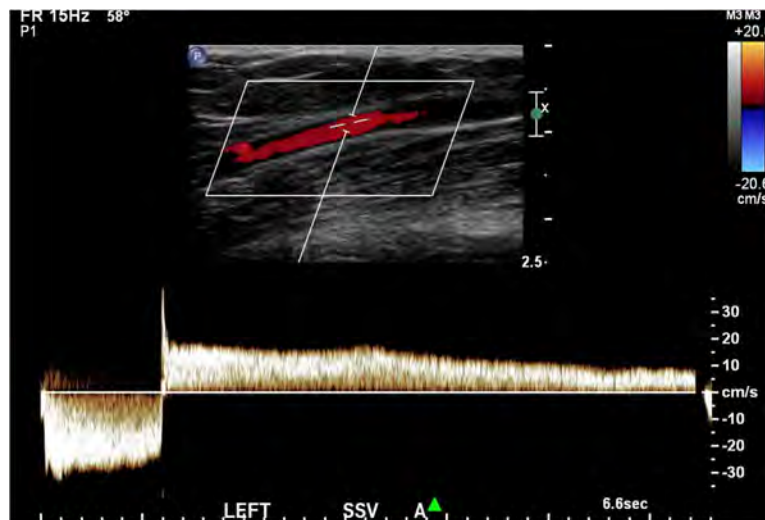


Venous Anatomy Mapping



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SSV Thigh extension spectral Doppler showing reflux

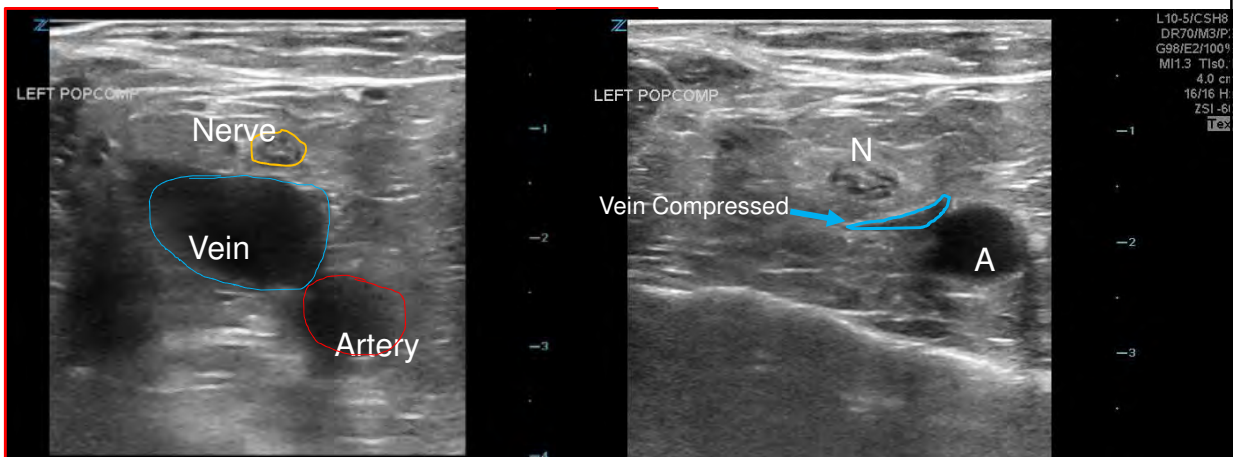


SSV, Sural nerve, and tributaries in superficial venous compartment



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Note proximity to nerves (especially intra-op)

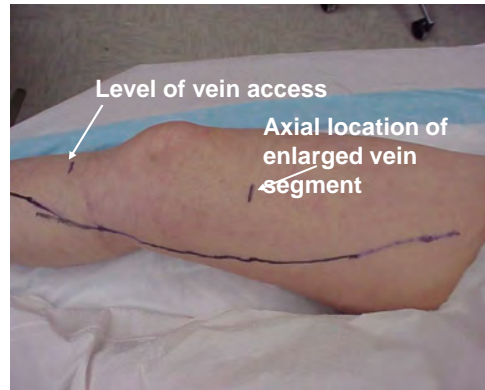


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Pre-op Duplex Assessment and Marking

Mark vein to be treated:

- Min. & max. vein diameters and depths
- Aneurysmal, tortuous segments, major tribs and perforators
- Vein depths <10mm from skin surface
- Potential access sites



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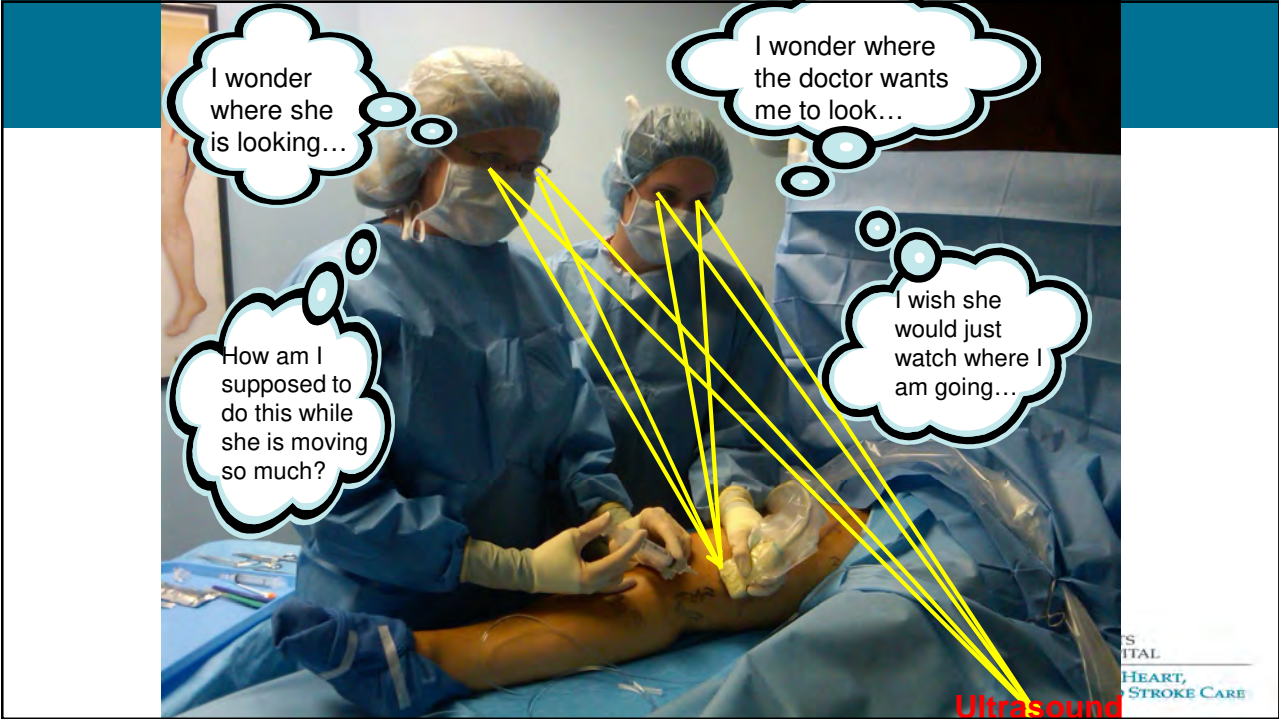


Intra Operative Duplex Scanning

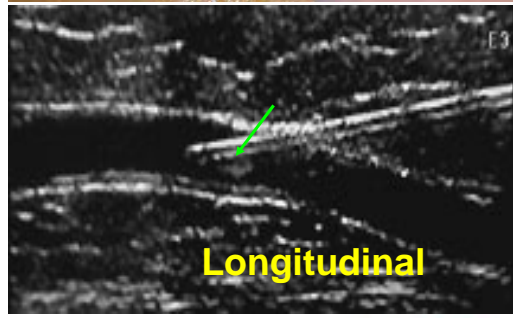


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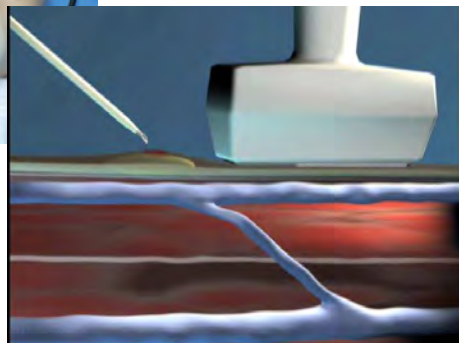
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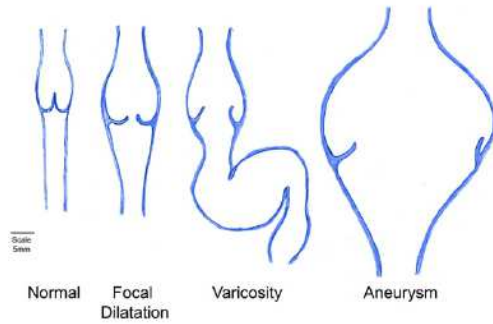
Ultrasound Guided Access



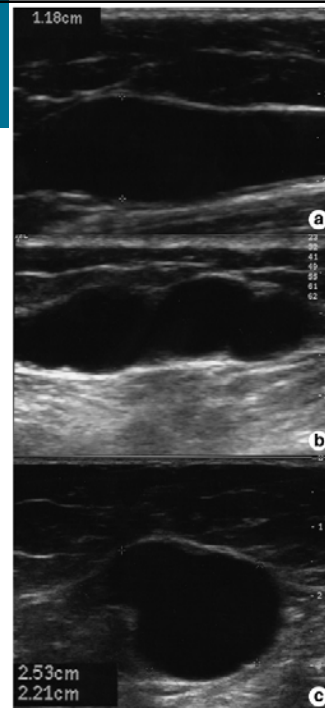
Guidance for Perforator Ablation



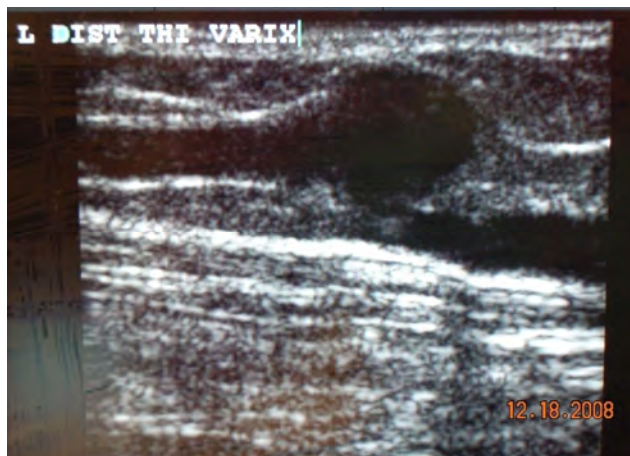
Intra-operative Assessment of Venous Anomalies



Labropoulos, N et al. JVS 2010;51:96-103



Intra-Operative Anatomy: GSV Varices



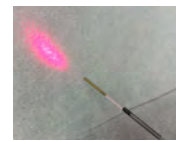
Treatment options for incompetent Saphenous Veins: *Thermal Ablation*

Endovenous Thermal Ablation:

- Recommended above stripping and ligation
- Needs tumescent anesthesia (more painful)
- Difficult in tortuous veins, needs to be negotiated by catheter or fiber
- Beware of veins adjacent to skin or nerves

THERMAL / TUMESCENT

- Radiofrequency (RFA):
 - 3 cm and 7 cm segmental heat
 - may have less pain and bruising immediately post op
- Laser (EVL):
 - Continuous delivery from fiber tip
 - Wavelengths: 810, 940, 980, 1064, 1320, 1470 nm
 - Fibers: Bare, coated/ jacket or radial tip
- Steam (investigational)



EVL

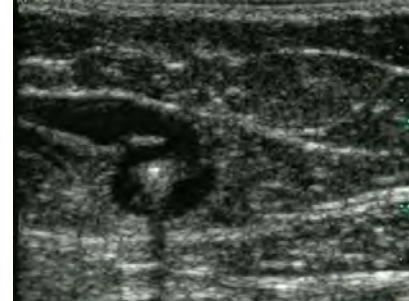


RFA

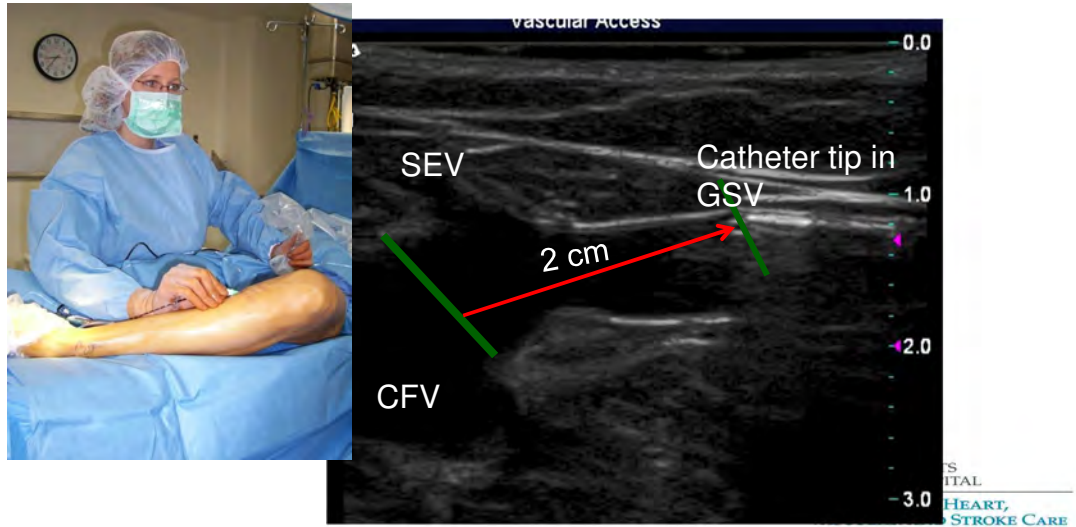
Thermal Ablation NEEDS Adequate Tumescent Anesthesia

- Exsanguinate vein being treated, and achieve better vein wall contact
- Protect against thermal skin injury
- Provide local anesthesia
- Recipe: 500cc NS, 20cc 1% Lido w epi, 10cc Bicarb
- Recommended Max Doses: 5-7 mg/kg Lidocaine with epinephrine

Saphenous Sheath



Intra-operative Catheter Placement



Treatment options for incompetent Saphenous Veins: *Non-Thermal Ablation*

- Best for patients with veins close to the skin or nerves
- Tortuous veins can be treated
- No need for tumescent anesthesia
- Appears to have less pain intra-op and post op
- Long term data re. closure rates and durability are still pending

Treatment options for incompetent Saphenous Veins: Non-Thermal Ablation

NON-THERMAL / NO-TUMESCENT

1. Endovenous Mechano- Chemical Ablation (MOCA)
 - Cannot be used if there are any webs or synechia
2. Cyanoacrylate Adhesive Glue:
 - Only trunk veins, does NOT enter tributaries
3. US guided injection sclerotherapy/ Chemical ablation
 - Best for patients who have tortuous vessels
 - Can treat trunk veins and tributaries
 - Liquid
 - Foam (homemade or canister)

Endovenous Non-Thermal Ablation:

- Best for patients with veins close to the skin or nerves
- No need for tumescent anesthesia
- Appears to have less pain intra-op and less pain Post op?
- Long term data re. closure rates and durability are still pending

REVIEW ARTICLES

Cynthia K. Shortell, MD, SECTION EDITOR

An update on the currently available nonthermal ablative options in the management of superficial venous disease



Nathan W. Kugler, MD, and Kellie R. Brown, MD, Milwaukee, Wisc

ABSTRACT

Background: Chronic venous insufficiency affects millions of Americans with symptoms spanning a broad range. Saphenous incompetence resulting in chronic reflux is at the root of most disease and is amenable to surgical correction.

Methods: We conducted a systematic review of the literature on nonthermal ablative techniques using a MEDLINE (Ovid) search from January 2000 to August 2016. Only prospective studies and literature review articles in the English language were included for final analysis.

Results: A total of 358 unique articles were identified, with a total of 60 articles meeting the stated inclusion and exclusion criteria. Historically, nonthermal ablative techniques have not demonstrated clinical results on par with thermal ablative interventions. However, three newer nonthermal ablative techniques have become available for use in the United States. Review of the literature demonstrated significant improvements in nonthermal ablative results, with intermediate-term data suggesting improved durability.

Conclusions: Advances in nonthermal ablative techniques have led to a developing role and acceptance in the primary management of varicose veins and venous insufficiency, even in the setting of challenging cases. (J Vasc Surg: Venous and Lym Dis 2017;5:422-9.)

Types of Non-Thermal Endovenous Ablation

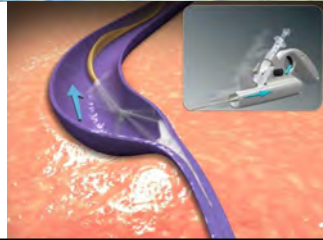
Mechanico-Chemical Ablation (MOCA)



- Catheter based
- No tumescent anesthesia

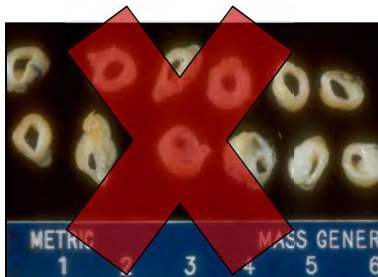


- No Tumescent needed
- 4 fr Micropuncture sheath
- Wire tip rotates to create intimal damage
- Pullback 1-1.5 mm/sec
- Inject sclerosant during pullback



Contraindications to MOCA

- Do NOT treat previously phlebotic veins which have recanalized
- The rotating wire can tangle on the synechiae and trabeculae of the recanalized vein which limits mechanical treatment

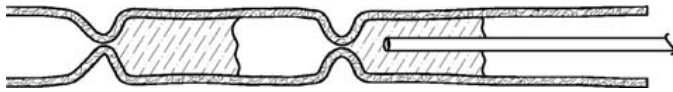


Types of Non-Thermal Endovenous Ablation

Cyanoacrylate Glue



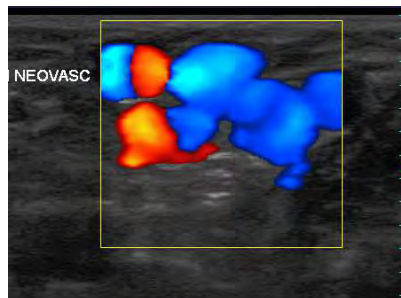
- Catheter based Glue delivery
- Best for long truncal veins
- Does NOT flow into tributaries
- No tumescent/ less painful
- No compression needed
- Avoid Allergic patients!



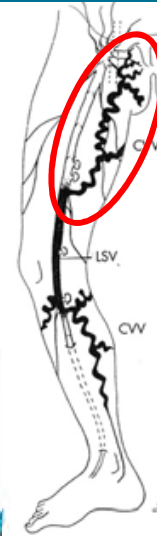
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What about refluxing veins NOT amenable to catheter ablation?

- Neovascularization
- Tributary veins
- Tortuous intrafascial veins
- Recanalized Veins
- Tortuous Perforator veins
- Pudental/ labial veins



Kindly provided by
Professor van Rij



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Types of Non-Thermal Endovenous Ablation

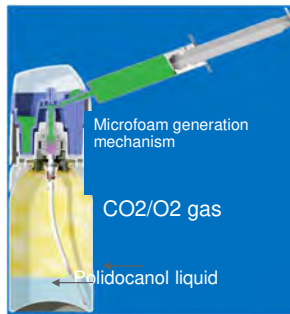
Chemical Ablation – FOAM

Liquid Sclerotherapy

- Ultrasound Guided
- Vein light guided

Foam – Displaces blood

- Proprietary/ canister foam
 - CO2 and O2 based
 - Micro-filters
 - More stable/ less embolic
 - FDA Approved
 - Expensive
- Homemade foam
 - N2 (room air) based
 - Lower closure rates



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Immediate Post Procedure Ultrasound

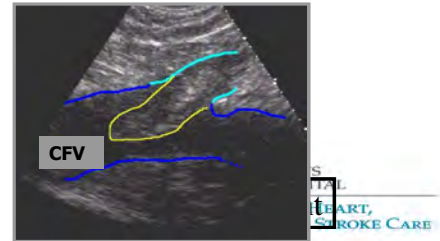


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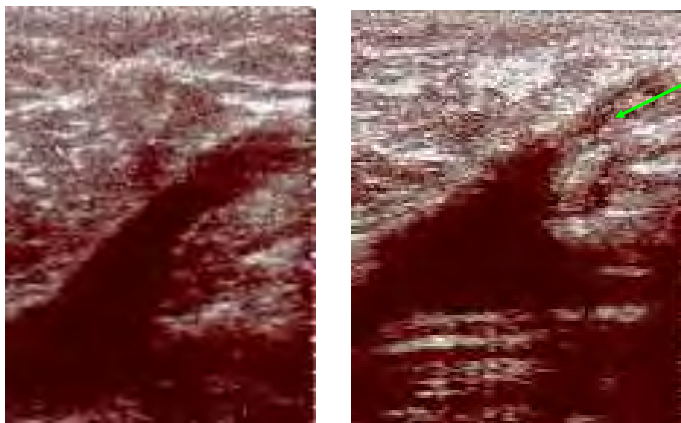
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Immediate Post Occlusion Duplex:

- Evaluate for DVT (standard protocol)
- Evaluate GSV for complete closure from the entry point to the deep vein junction
- Distance from the deep vein junction (SFJ or SPJ) to occluded segment (look for EHIT)
- Evaluate for reflux at the deep vein junction
- Treated vein's morphology (hyper/hypo-echoic, non-compressible, dilated/contracted, partially occluded, etc.)
- Can also evaluate for open junctional tributaries, large patent tribs or perforators



Post-Operative Duplex Scan

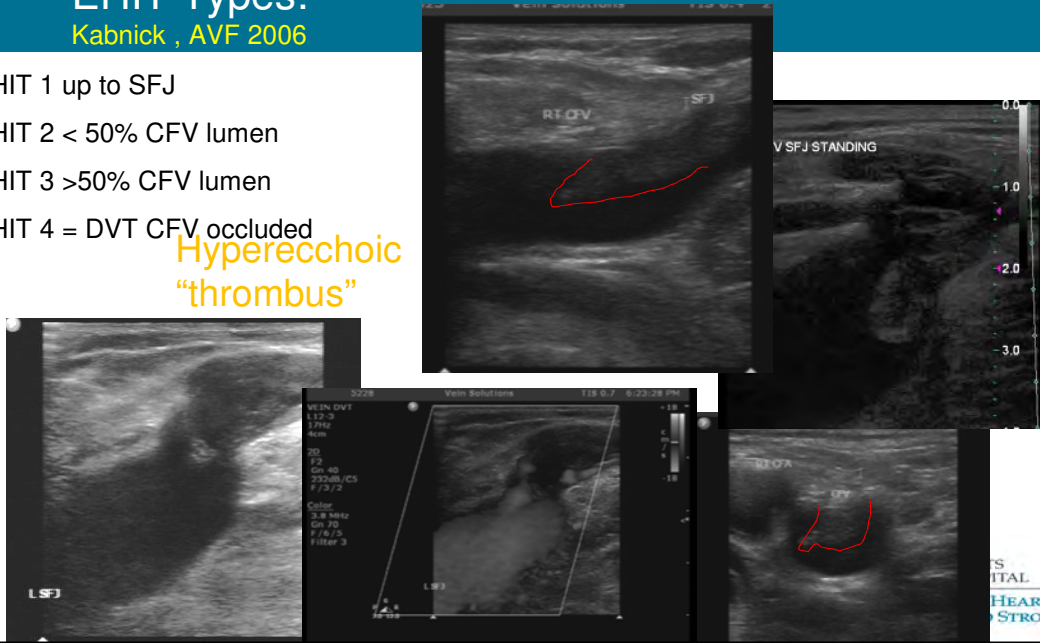


EHIT Types:

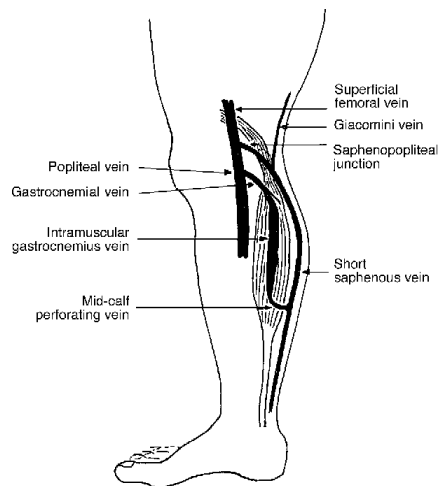
Kabnick, AVF 2006

- EHIT 1 up to SFJ
- EHIT 2 < 50% CFV lumen
- EHIT 3 >50% CFV lumen
- EHIT 4 = DVT CFV occluded

Hypercholechoic
"thrombus"

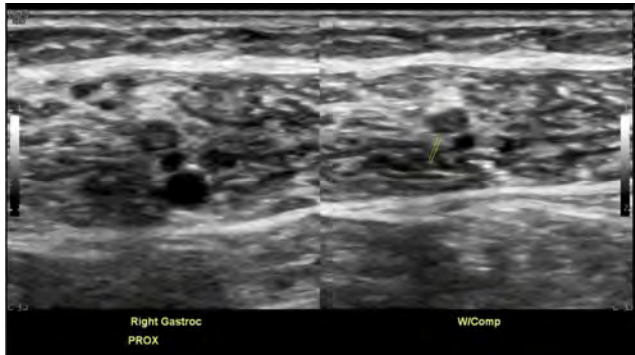


Calf Veins should be examined on DVT studies, and post op studies

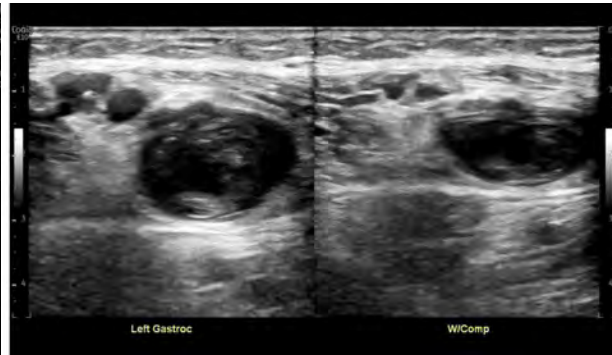


Importance of Veins in the Calf Muscles

Chronic Thrombus 1 of 2 Gastroc V



Large Partially thrombosed Gastroc Sinus Veins



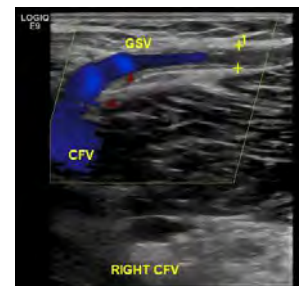
Slide c/o Ryan Brooks RVT, MGH Vein Center

Post procedure follow up Ultrasound

Reporting Standards: AVF and SIR, JVIR 2009; 20:S417-S424

“Follow-up duplex US examinations should be periodically performed to evaluate the anatomic success of EVTA”

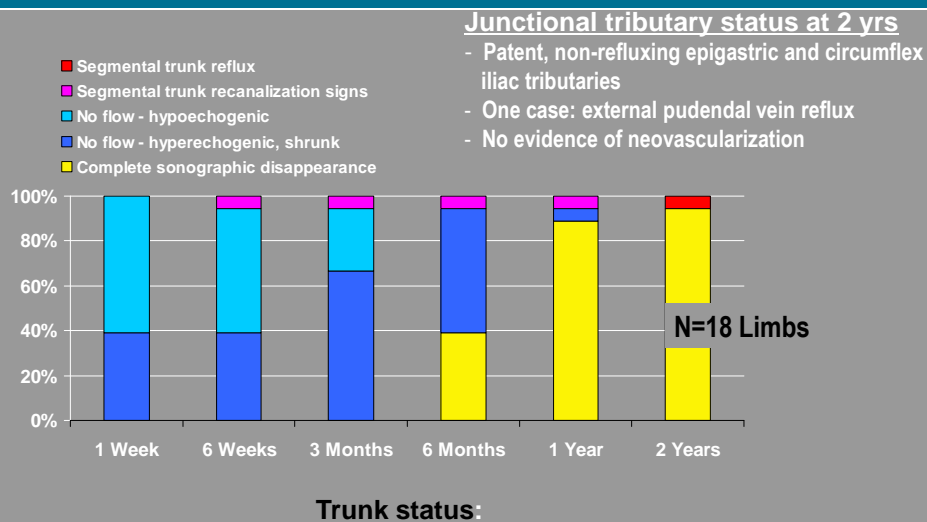
- Goal (anatomic success):
 - Acute vein wall thickening without significant intraluminal thrombus in the first few weeks after treatment
 - Over the next few months by progressive vein shrinkage and eventual disappearance on US examination
 - Note any recurrent reflux in treated or adjacent veins over years... Natural history is still unknown



Follow up POST endovenous ablation duplex scans should include:

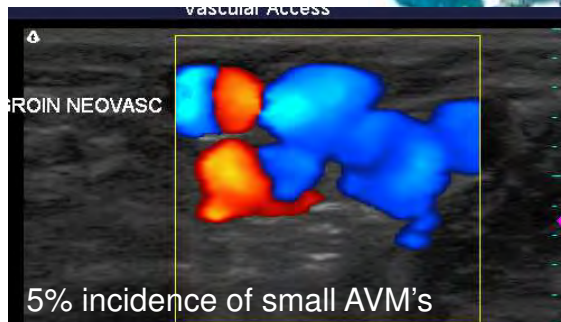
- Evaluation for DVT
- Evaluation of treated vein(s) for patency, distance to point of occlusion, appearance of the segment of vein treated, signs of recanalization, patency of any major tributaries or perforators, etc.
- Evaluation of junctional tributaries, new refluxing veins, neovascularization
- Ask the patient if there are any NEW areas and examine for recurrences

Duplex-Scanning of the GSV (Radiofrequency data)



Neovascularization: Rare after EVTA

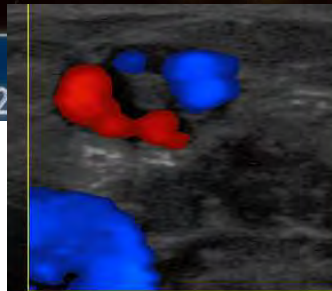
Labropoulos et al, Neovascularization After Great Saphenous Vein Ablation. Eur J Vasc Endovasc Surg 2006



Kindly provided by Professor van Rij

5% incidence of small AVM's
Neovascularization after Laser > RF, p
Neovascularization after Stripping >> E

Recanalized Veins (with or without reflux)



THANK YOU



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