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Society for Vascular Medicine

POCUS Workshop

Lower Extremity Deep Vein Thrombosis

ACP®

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Objectives

01	02	03	04	05	06
Review evidence for POCUS to r/o DVT	Review basic venous anatomy of legs	Learn normal ultrasound appearance	Learn appearance of acute/chronic DVT	Review pitfalls of CUS	Review non-thrombotic incidental findings

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Why POCUS DVT

- Rapid diagnosis to expedite treatment and lower risk of life-threatening complications
- Limited availability of professional ultrasonographers on nights and weekends
- POCUS for diagnosis of DVT validated in ED, wards, and critical care settings

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Evidence

Current guidelines continue to support limited CUS by trained clinicians for proximal DVT

- Systematic review of emergency physician-performed ultrasonography for lower-extremity deep vein thrombosis. *Acad Emerg Med.* 2008;15(6):493-498
  - 936 patients
  - 95% sensitivity, 96% specificity
- Accuracy of emergency physician-performed ultrasonography in the diagnosis of deep-vein thrombosis: a systemic review and meta-analysis. *Thromb Haemost.* 2013;109(1):137-145
  - 2,379 patients
  - 96.1% sensitivity, 96.8% specificity
- Hospitalist-Operated Compression Ultrasonography: a Point-Of-Care Ultrasound Study (HOCUS-POCUS). *J Gen Intern Med.* 2019;34(10):2062-2067
  - 100% sensitivity, 96% specificity, negative predictive value 100%
- A preliminary study of intensivist-performed DVT ultrasound screening in trauma ICU patients (APSIT Study). *Ann Intensive Care*. 2020;10(1):122

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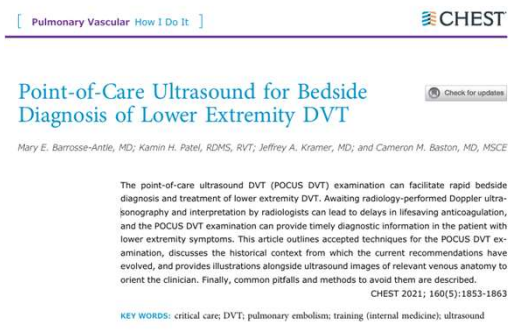
Excellent Reviews

CHEST 2021; 160(5):1853-1863



[Pulmonary Vascular How I Do It] CHEST

Point-of-Care Ultrasound for Bedside Diagnosis of Lower Extremity DVT

Check for updates

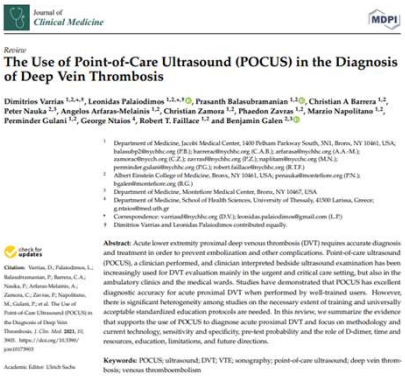
Mary E. Barrosse-Antle, MD; Kamin H. Patel, RDMS, RVT; Jeffrey A. Kramer, MD; and Cameron M. Baston, MD, MSCE

The point-of-care ultrasound DVT (POCUS DVT) examination can facilitate rapid bedside diagnosis and treatment of lower extremity DVT. Awaiting radiology-performed Doppler ultrasonography and interpretation by radiologists can lead to delays in lifesaving anticoagulation, and the POCUS DVT examination can provide timely diagnostic information in the patient with lower extremity symptoms. This article outlines accepted techniques for the POCUS DVT examination, discusses the historical context from which the current recommendations have evolved, and provides illustrations alongside ultrasound images of relevant venous anatomy to orient the clinician. Finally, common pitfalls and methods to avoid them are described.

CHEST 2021; 160(5):1853-1863

KEY WORDS: critical care; DVT; pulmonary embolism; training (internal medicine); ultrasound

J Clin Med. 2021;10:3903.



Journal of Clinical Medicine MDPI

Review

The Use of Point-of-Care Ultrasound (POCUS) in the Diagnosis of Deep Vein Thrombosis

Dimitrios Varrias [1,2,*,†], Leonidas Palaiodimos [1,3,*,†], Prasanth Balasubramanian [1,2], Christian A Barrera [1,2], Peter Nzuka [2,3], Angelos Arfaras-Melainis [1,2], Christian Zamora [1,2], Phaedon Zavras [1,2], Marzio Napolitano [1,2], Perminder Gulani [1,2], George Ntaios [4], Robert T. Faillace [1,2] and Benjamin Galen [1,3]

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† Dimitrios Varrias and Leonidas Palaiodimos contributed equally.

check for updates

Citation: Varrias, D.; Palaiodimos, L.; Balasubramanian, P.; Barrera, C. A.; Nzuka, P.; Arfaras-Melainis, A.; Zamora, C.; Zavras, P.; Napolitano, M.; Gulani, P.; et al. The Use of Point-of-Care Ultrasound (POCUS) in the Diagnosis of Deep Vein Thrombosis. J. Clin. Med. 2021, 10, 3903. https://doi.org/10.3390/jcm10173903

Academic Editor: Ulrich Sachs

Abstract: Acute lower extremity proximal deep venous thrombosis (DVT) requires accurate diagnosis and treatment in order to prevent embolization and other complications. Point-of-care ultrasound (POCUS), a clinician performed, and clinician interpreted bedside ultrasound examination has been increasingly used for DVT evaluation mainly in the urgent and critical care setting, but also in the ambulatory clinics and the medical wards. Studies have demonstrated that POCUS has excellent diagnostic accuracy for acute proximal DVT when performed by well-trained users. However, there is significant heterogeneity among studies on the necessary extent of training and universally acceptable standardized education protocols are needed. In this review, we summarize the evidence that supports the use of POCUS to diagnose acute proximal DVT and focus on methodology and current technology, sensitivity and specificity, pre-test probability and the role of D-dimer, time and resources, education, limitations, and future directions.

Keywords: POCUS; ultrasound; DVT; VTE; sonography; point-of-care ultrasound; deep vein thrombosis; venous thromboembolism

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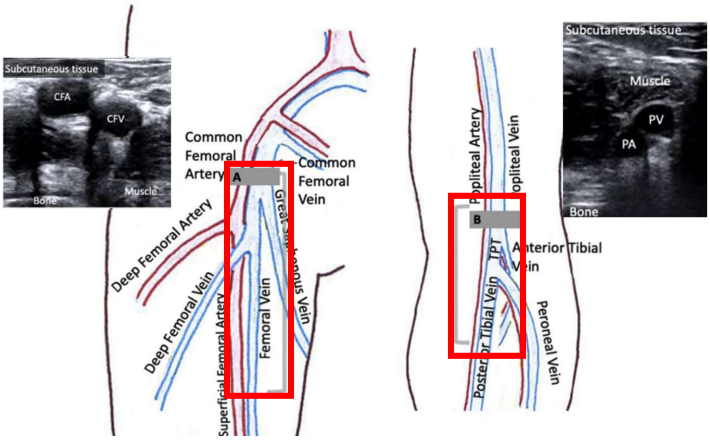
Scanning Protocol (Two Zone)

Zone 1: CF, DF, GS, Fem

Zone 2: PV, AT, TPT, PT and peroneal veins



CHEST 2021; 160(5):1853-1863

- **POCUS = Limited Proximal Compression Ultrasound (not whole-leg)**
  - Two-point/Three-point
  - Two-Zone (better for ED/ICU)

Lower Extremity Venous Anatomy

- **CFV** at inguinal ligament
- Veins medial to artery
- CFV divides proximally
- **Femoral** vein posterior
- Femoral vein dives deep at adductor hiatus
- Becomes **popliteal** vein
- Tibioperoneal trunk

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Distal (Calf) DVT

- Proximal deep veins:
  - Common femoral, deep femoral, femoral, popliteal veins
- Distal deep veins:
  - Anterior tibial, tibioperoneal trunk, peroneal, posterior tibial veins

- *Isolated distal (calf) DVT may be missed with limited CUS*
- **If clinical suspicion remains high, formal duplex or repeat imaging is recommended**

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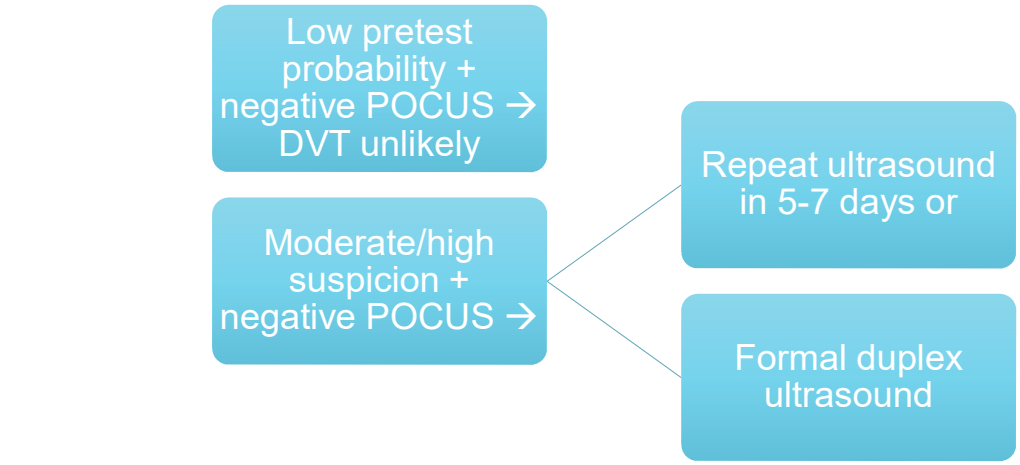
Follow-up Pathway: when POCUS is negative



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Ultrasound Performed by Emergency Physicians for Deep Vein Thrombosis: A Systematic Review

- 15 studies, 2511 POCUS exams (2012 onward)
- Sensitivity 90%, specificity 95%
- Highest accuracy with experienced operators
- 3-point compression slightly more sensitive than 2-point
- Trained clinicians can accurately diagnose DVT using limited CUS at the bedside

Levine RL et al. West J Emerg Med. 2024.

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Image characteristics of normal veins

- Lumen should anechoic or black
- Surrounding tissue hyperechoic or bright
- Slow flow may be seen, “spontaneous echo contrast”
- Thin walled
- Valves present
- Compress easily (transverse)
- Not pulsatile
- Slightly larger to corresponding artery

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Getting started: Transducers

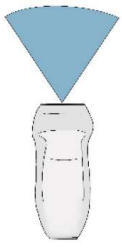
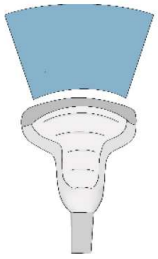
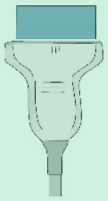
Transducer Type	Phased array	Curvilinear	Linear
Frequency	1-5 MHz	2-5MHz	5-10Mhz
Debth	35cm	30cm	9cm
			Used for DVT diagnosis 
Applications	Heart,lungs, pleura, abdomen	Gallbladder, kidney, liver, bladder, uterus, ovaries, aorta	Arteries, veins, skin, muscoloskeletal, testicles, eyes, breast

Figure 1. The three types of transducers used in point-of-care ultrasound (POCUS). The linear transducer (light green) is preferred for the evaluation of veins. DVT = deep vein thrombosis.

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Lower Extremity CUS: Technique

- Supine with external rotation of hip (frog leg)
- Consider patient comfort (place rolled towel) AND your comfort (raise bed)
- High frequency linear
- Identify CF, femoral, and popliteal veins
  - 1-2 cm increments
  - Until tibioperoneal trunk

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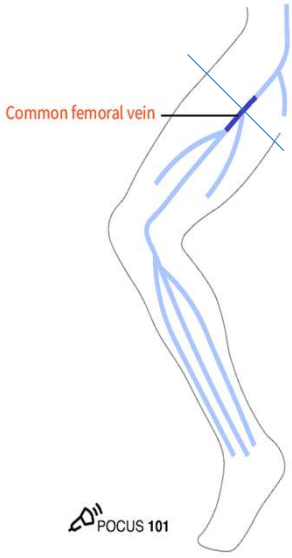

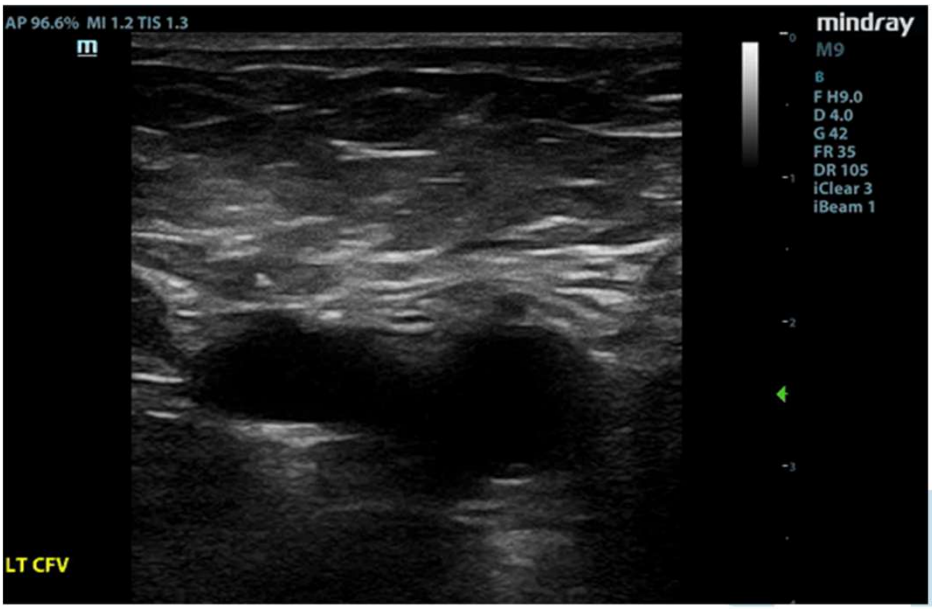

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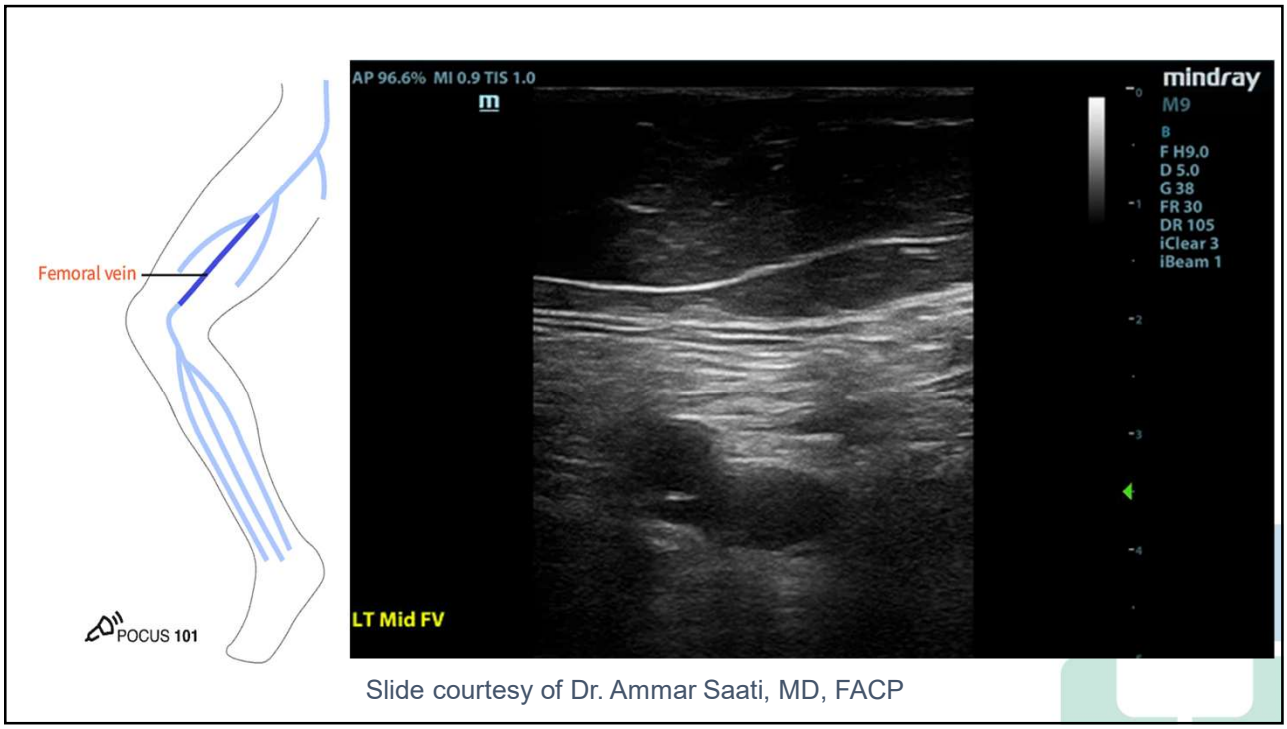

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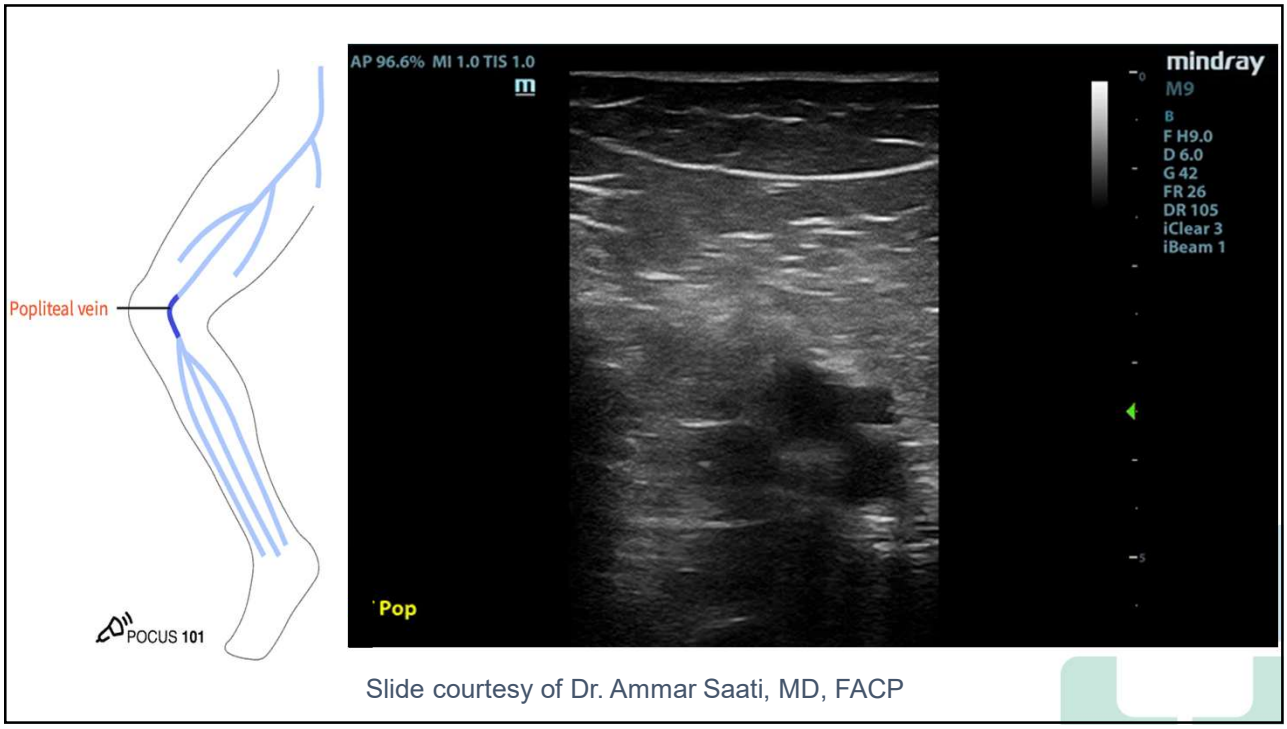

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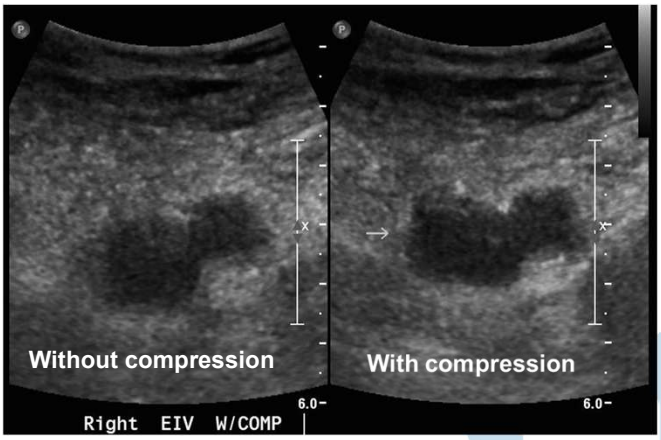
Diagnosis of **Acute DVT**

- Noncompressible
- Vein distended
- Low echogenicity
- Soft and spongy texture



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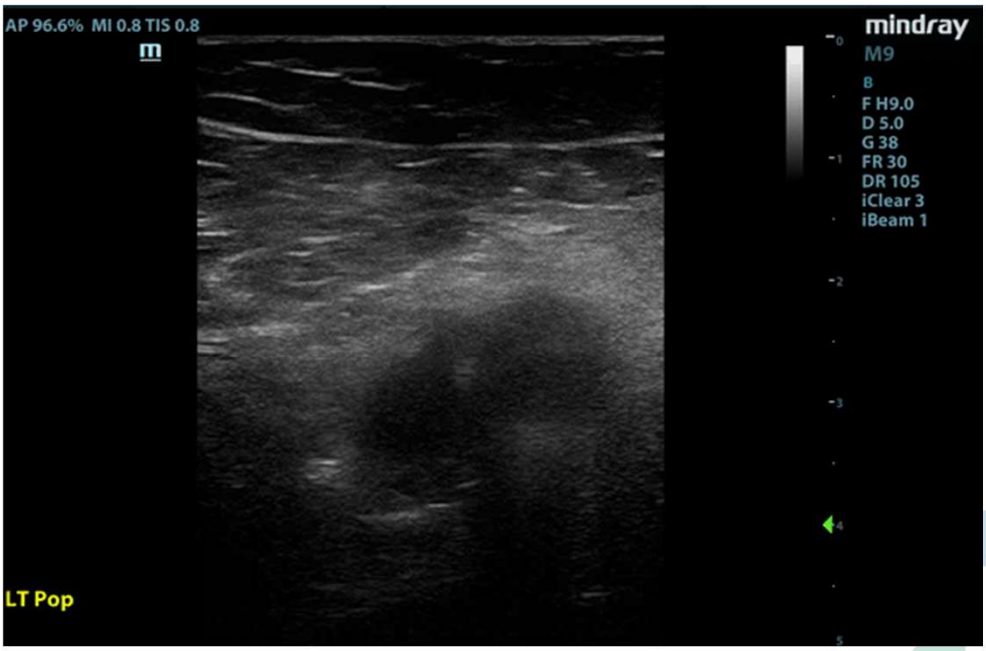

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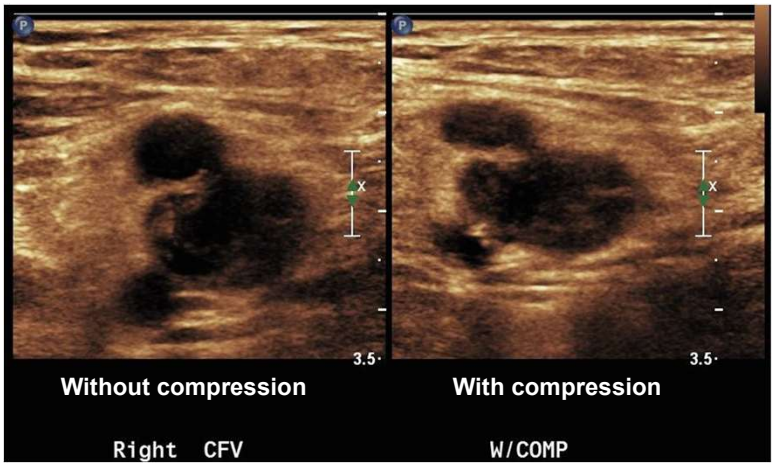
Acute DVT



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Acute DVT

- Thrombus may be poorly attached to vein wall or “free-floating” with mobile tail

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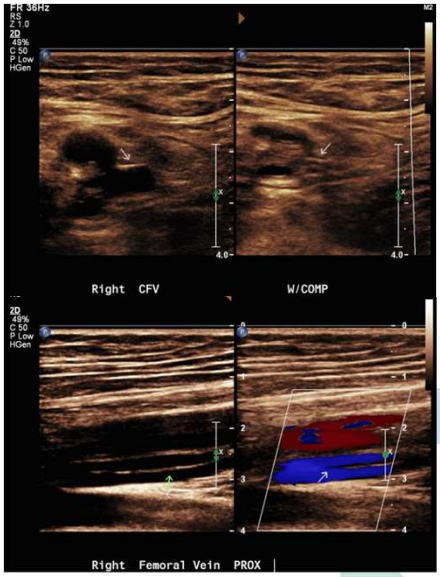
Post thrombotic change (Chronic)

- Partially compressible
- Not distended
- Organized (bright)
- Web-like
- May be smaller than artery
- Firm with probe pressure



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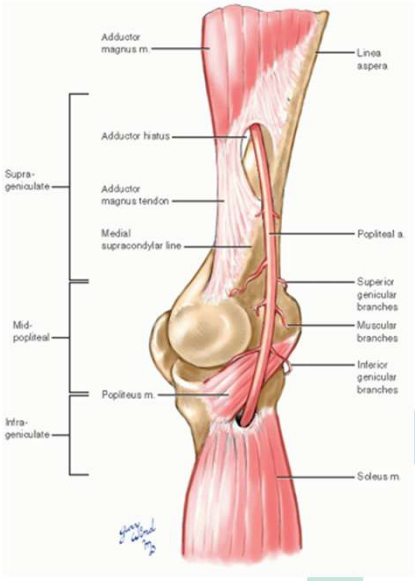
Pitfalls

- Body habitus
  - Suboptimal images
  - Difficulty compressing
- Edema
- Adductor hiatus preventing compression
- Calcific shadowing from atherosclerotic plaque



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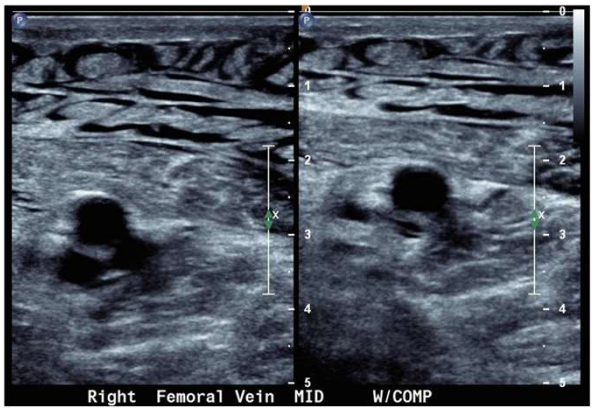
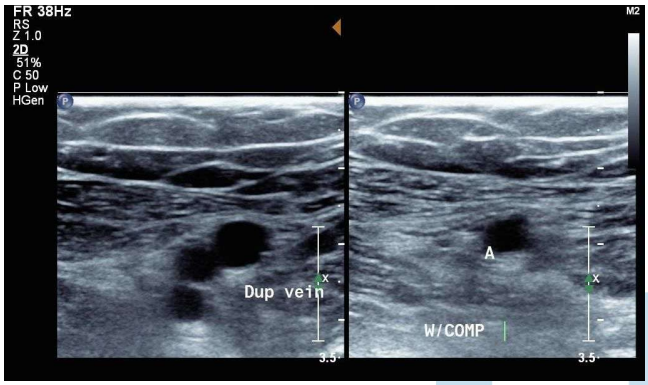
Edema and Duplicated Veins





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Non-thrombotic findings

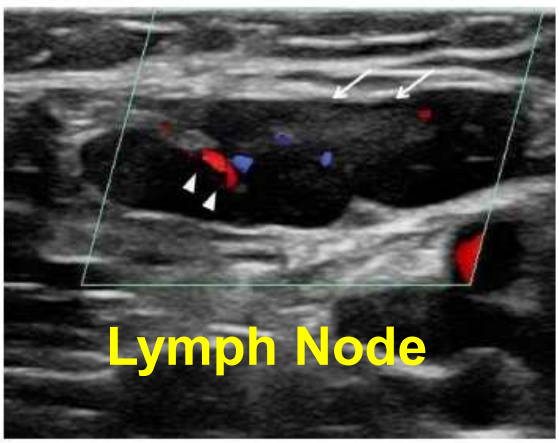

Figure 2. Enlarged inguinal lymph node (arrows) demonstrating flow in the hilar region with Color Doppler (arrowheads).

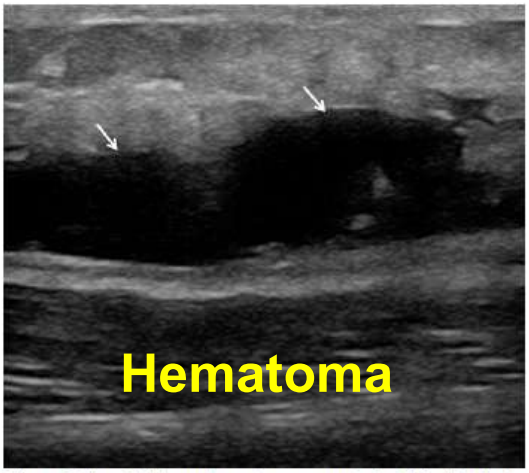

Figure 3. Liquefied hematoma (arrows, anechoic fluid collection).

Adhikari et. al. West J Emerg Med. 2015

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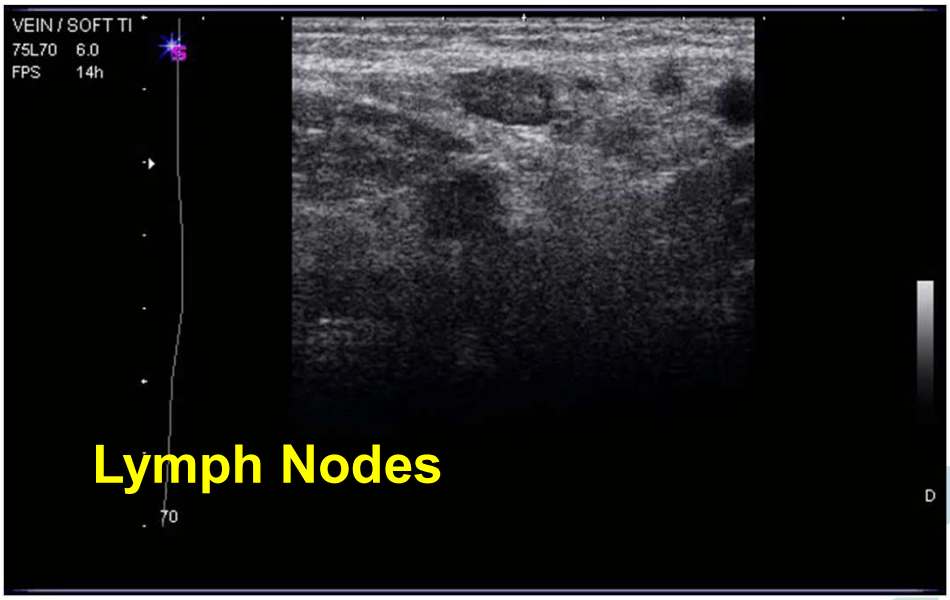

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Non-thrombotic findings

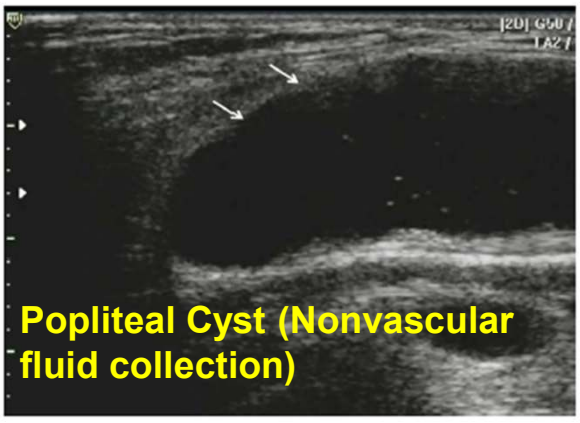

Figure 1. Baker's cyst (arrows, anechoic distension of the semimembranosus-medial gastrocnemius bursa).

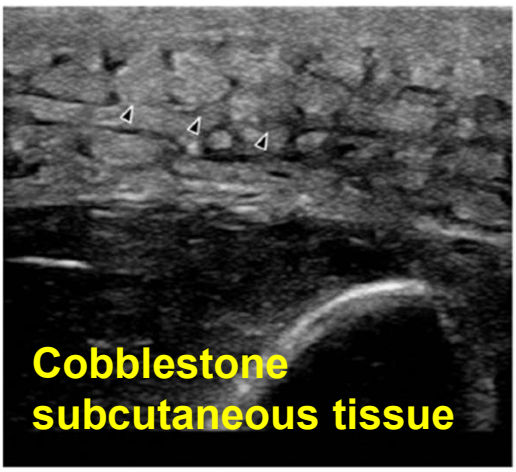

Figure 4. Cobblestone appearance (arrowheads) of subcutaneous tissues suggesting cellulitis.

Adhikari et. al. West J Emerg Med. 2015

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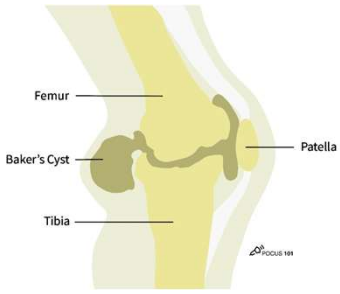

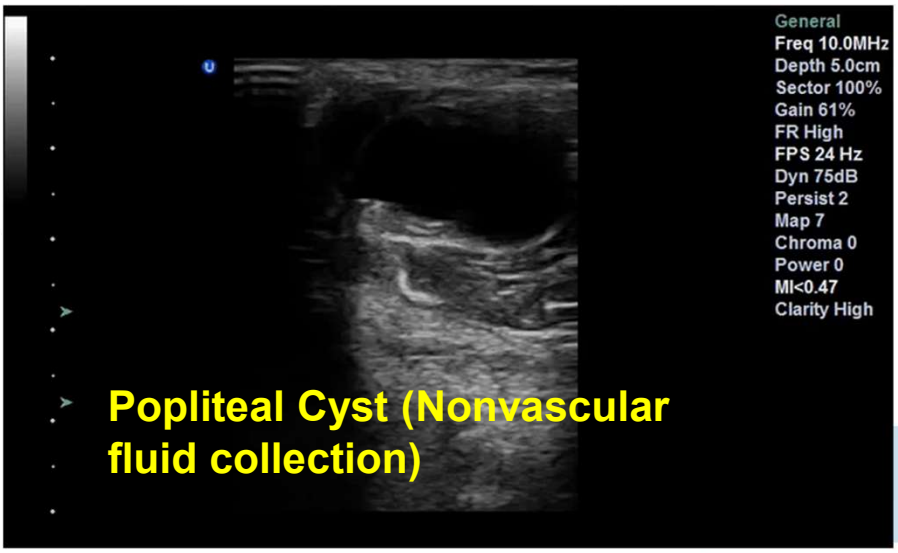

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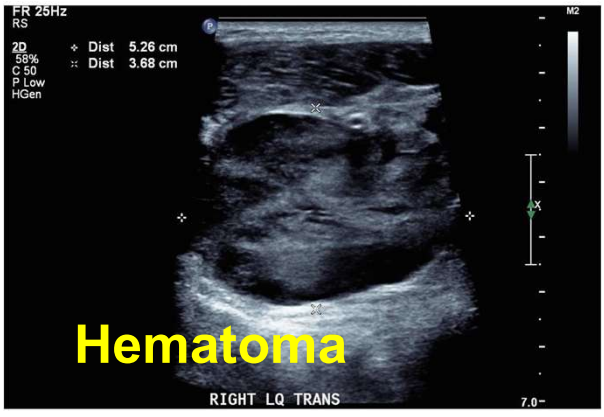
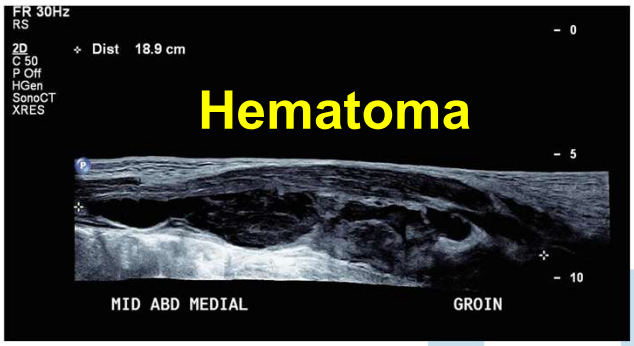
Non-thrombotic findings





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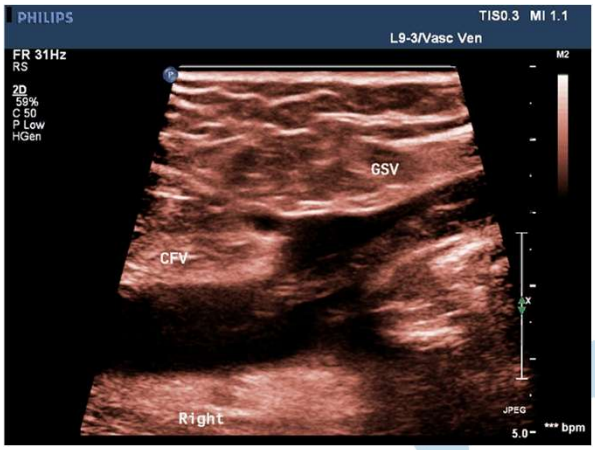
Superficial veins

- GSV & SSV
- May present with superficial thrombophlebitis (groin to distal lower leg, posterior knee to ankle, may involve varices arising off GSV/SSV)
- Thrombus can extend from superficial into deep veins (if within 3 cm of deep vein treat as DVT)



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Final points

- Lack of compressibility is most important criteria for acute DVT
- Fresh thrombus is faintly echogenic, so visualizing the vein is not enough to rule out DVT
- Post thrombotic change is brightly echogenic, partially compressible, and vein is not distended
- Non-thrombotic findings may be significant
- Superficial vein thrombus can extend into deep veins
- Assess the symptomatic area

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