OTTAWA DVT POCUS HANDBOOK

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PREFACE FROM THE AUTHOR & EDITORIAL TEAM

Welcome to the Ottawa *DVT PoCUS Handbook*—a practical guide for emergency physicians enhancing their point-of-care ultrasound (PoCUS) skills.

Crafted by emergency medicine physicians for emergency medicine physicians, this concise handbook offers a clear, evidence-based protocol and practical scanning tips for the proximal DVT evaluation.

Whether you are new to DVT PoCUS or refining your expertise, you will find essential insights tailored for real-world practice.

We hope this guide becomes a trusted companion on your path to PoCUS mastery and helps continually improve your patient care.

KEY CLINICAL QUESTION

Does this Patient have a Proximal Deep Vein Thrombosis?

OBJECTIVES

I. Understand the indications and clinical value of DVT PoCUS.
II. Review the venous anatomy of the leg.
III. Compare and contrast DVT PoCUS protocols described in the literature.
IV. Develop a framework for performing a DVT PoCUS examination.
V. Acquire and interpret ultrasound images of the proximal deep veins.
VI. Identify potential pitfalls and false positives when diagnosing DVT.
VII. Apply knowledge to real-world emergency department (ED) cases.

I. INTRODUCTION

Deep vein thrombosis (DVT) is a common emergency department (ED) diagnostic consideration for patients presenting with leg-related complaints. In fact, locally, there are more than 300 patients diagnosed with a lower limb DVT annually at The Ottawa Hospital.

It is estimated that as many as 1 in 10 ED patients are evaluated for venous thromboembolism (VTE), encompassing either DVT or PE.[1] This is due to the subtle and non-specific presentation of VTE, in addition to potential life-threatening harms of a missed diagnosis. However, over-testing for VTE carries risks, including unnecessary resource utilization and patient harm.[2-3]

Historically, ED physicians have relied on clinical gestalt and risk stratification tools to guide DVT testing. The traditional **Wells DVT Score** is a widely used tool to estimate pretest probability, categorizing patients as low, moderate, or high risk.[4]

- **Low Risk (0 or less)**: A negative D-dimer effectively rules out DVT.
- **Moderate (1–2) or High Risk (> 2)**: Ultrasound is often recommended.

However, this approach has limitations:

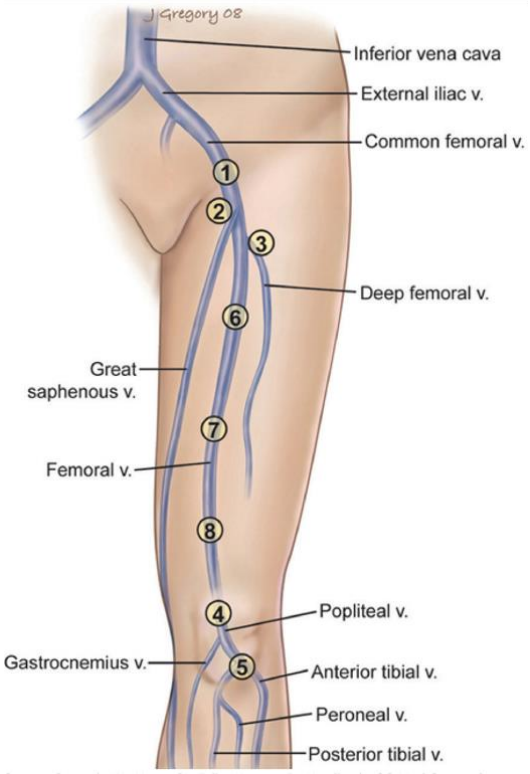
1. **Positive D-dimer Challenges**: Conditions like age, immobility, malignancy, pregnancy, hemodialysis, and recent surgery falsely elevate D-dimer levels.[5]
2. **Logistical Barriers**: Radiology-performed ultrasound is often not often available outside of daytime regular hours and can add many hours to an ED visit.

In response, ED-performed **DVT PoCUS** has become a valuable tool for DVT diagnosis, offering immediate and actionable clinical results at the bedside.

II. ANATOMY BACKGROUND

The deep venous system of the leg is divided into proximal and distal veins, separated by the popliteal vein.

Proximal DVTs (50–70%): Occur in the popliteal vein or above.[6]
Distal DVTs (30–50%): Found in the anterior tibial, posterior tibial, or peroneal veins.



Clinical Implications of DVT Location

Proximal DVTs:

- Less likely to resolve spontaneously.
- Higher risk of embolization and complications such as post-thrombotic syndrome (PTS).
- **Require anticoagulation in almost all cases**.[7]

Distal DVTs:

- Anticoagulation may not always be necessary. [6,7] According to **Thrombosis Canada**, low-risk patients can be managed with a repeat ultrasound and clinical examination in 1-week to ensure no proximal extension. Only **10–15%** of distal DVTs will extend proximally.
- Locally, **low-risk patients are often not anticoagulated** and may be referred to outpatient thrombosis for further evaluation following a shared decision-making process. The decision to treat will depend on multiple factors including symptom burden, bleeding risk, and comorbidities so when in doubt, it is advisable to liaise with the thrombosis team to ensure optimal patient management.

III. DIFFERENT DVT PoCUS PROTOCOLS EXPLAINED

2-Point? 3-Point? 2-Zone? More?

The nomenclature of DVT PoCUS protocols can be **confusing**. However, all protocols share **a common goal**: a focused examination of the proximal deep veins. Notably, the distal deep veins (beyond the popliteal trifurcation) for so-called "**below knee DVT" are typically not fully evaluated.** This limitation should be communicated clearly when obtaining consent and explaining results to patients.

A key distinction between protocols lies in the terms "points" and "zones".

- **Points:** Refer to scanning specific, focal locations on the leg. For example, the common femoral vein (CFV) at the saphenofemoral junction (SFJ).
- **Zones**: Refer to scanning through a defined region on the leg. For example, the proximal femoral zone, which includes the CFV, SFJ, deep femoral vein (DFV), and femoral vein (FV) branching.

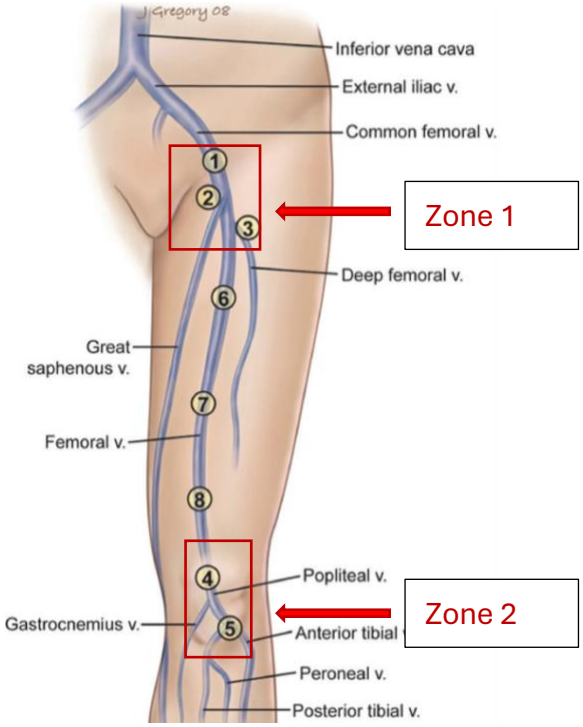
To clarify, consider an NFL Super Bowl game:

- The 20-yard line represents a specific **point** on the field.
- The defensive "red zone" refers to the **region** spanning from the 20-yard line to the goal line.

In the ED, **maximizing sensitivity is critical to ruling out DVT**. While some studies support the diagnostic value of a **2-point** scan that interrogates only the femoral and popliteal

veins, **a more comprehensive, zone-based protocol** is generally preferred to reduce the risk of missed thrombi.[8]

Adding to the confusion, some clinical studies refer to 2- or 3-point scans but describe scanning 1 cm above and below the site of interest in a manner resembling a zone-based approach. For consistency, **this handbook will refer exclusively to zone-based protocols moving forward.**



The Reference Standard and Sensitivity of DVT Ultrasound

The reference standard for ruling out DVT is a whole-leg duplex ultrasound, which includes compression testing, in addition to color and spectral doppler.[1]

Compared to this standard:

- A **2-point** compression protocol of the femoral and popliteal veins is both **80%** sensitive and specific in diagnosing DVT by emergency clinicians.[9]
- Comparatively, a **2-zone** compression protocol performed by a certified sonographer and interpreted by a radiologist, has a sensitivity and specificity of **~95%**.[1]
- DVT PoCUS performed by trained emergency clinicians demonstrates diagnostic accuracy of **90–95%**, comparable to radiology-performed ultrasound for proximal DVTs.[10-11]

Given the available evidence, this handbook outlines a **2-zone protocol.**

IV. APPROACH TO SCANNING

Preparation

1. Obtain informed consent.
2. Ensure the patient wears a hospital gown.
3. Gather supplies: ultrasound gel, a towel, and appropriate draping.

Patient Positioning

- Position the patient upright at 30–45 degrees with slight leg flexion and external rotation (frog-leg position).
- If the patient has limited hip abduction, consider rolling them onto their side.
- If the patient has difficulty holding the abducted position or experiences cramping, add a pillow under the knee for support.
- If you're struggling with popliteal visualization, reposition the patient to an upright sitting position with the leg hanging off the bed or in another gravitationally dependent position to maximize venous filling.

Ultrasound Setup

- **Probe**: Linear (12–4 MHz); rarely the curvilinear (C5–2 MHz) for obese patients.
- **Preset**: Venous or vascular.
- **Positioning**: Machine on the patient's right side for right-handed operators. This allows you to manipulate controls with your non-dominant hand.

Saving the Scan

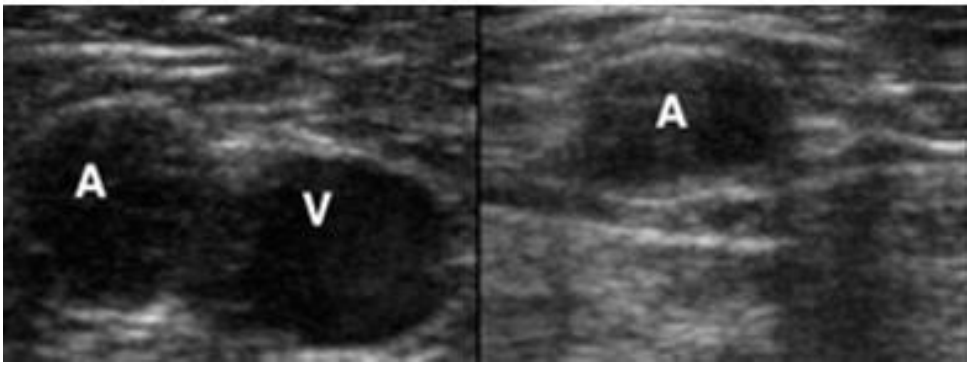
- The ideal **2-Zone DVT scan** involves **7 cine clips**:
- **Zone 1**: CFV (**1**), SFJ (**2**), Deep FV (**3**), FV (**4**)*
- **Zone 2**: Adductor Canal Distal FV (**5**), PV Fossa (**6**), PV Trifurcation (**7**)).

*The experienced operator might obtain more than 1 clip of the FV and follow it down as far as possible with compression every 1cm. This maximizes sensitivity, with literature finding 5.5% of lower extremity DVTs are isolated to the FV.[12]

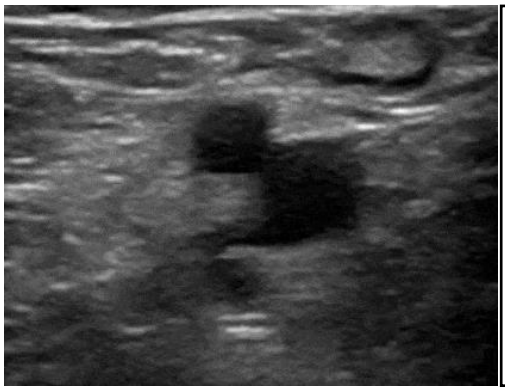
Note on Still Images vs Cine Clips

Note some resources and sonographers still rely on still images. The key differences are highlighted below.

1. **Still Images** – this involves two pictures of the vein prior-to and during compression demonstrating full collapsibility. This might be saved as a single, side-by-side split image comparison. However, two separate pictures are also adequate, as the split-screen knobology can be difficult to set-up.



2. **Cine Clip** – locally, this is our **preferred method** of archiving as it provides more dynamic information. Begin saving your clip with the probe gently over the area of interest, then apply controlled, downwards compression over the vein while keeping it centered in the screen and demonstrating full collapsibility.

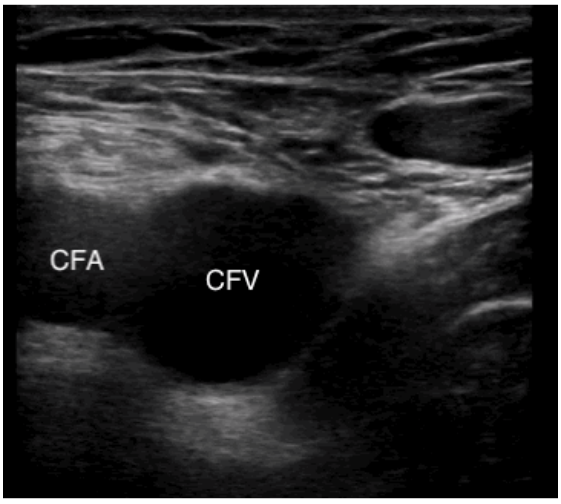


NOTE: For all further images, **click on the image** to view the corresponding **video.**

Zone 1

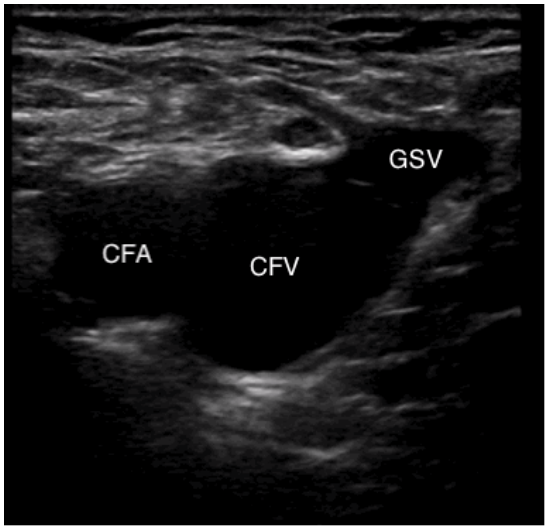
1. Common Femoral Vein (CFV)

- The landmarking is the same as a femoral line.
- Remain proximal near the inguinal ligament.
    - A common pitfall of beginners is starting too low. If you're too low, you'll miss the saphofemoral junction (SFJ).
    - A second common pitfall is applying too much pressure, inadvertently collapsing the vein you're trying to visualize.



2. Saphenofemoral Junction (SFJ)

- Slide 1-2cm down from the CFV. The first branch you see is the Greater Saphenous Vein (GSV) which will be travelling in the superior medial direction
- On the right leg, expect this in the 12-3 o'clock position as shown.
- Its good practice to follow the GSV medially away from the bifurcation, a clot within 5 cm of the bifurcation should be treated.

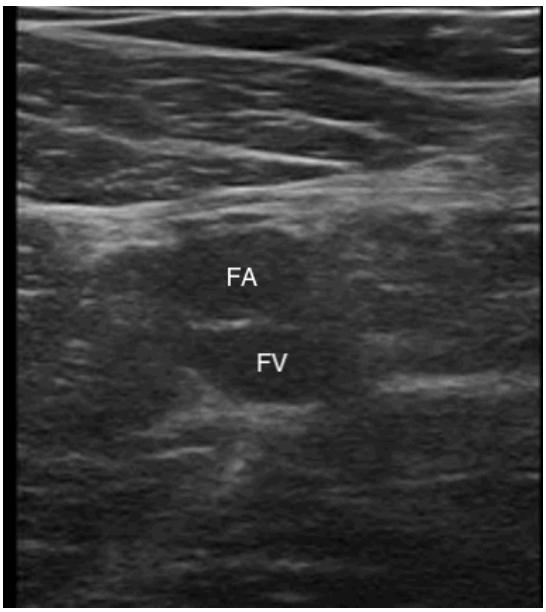


3. Deep Femoral Vein (DFV)

- Slide 1-2cm further down the CFV to find where it branches into the DFV and femoral vein (FV).
- The DFV will be in the far-field, often coursing below the artery, while the FV remains more proximal.

4. Femoral Vein (FV)

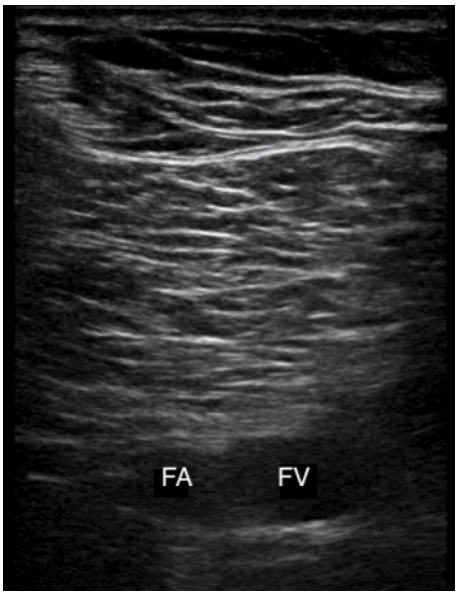
- This was formally called the superficial femoral vein (SFV). While relatively more superficial to skin than the DFV, it's a part of deep venous system. Thus, to avoid confusion it was renamed to FV.
- Continue to slide a few cm down the leg and follow the FV.



Zone 2

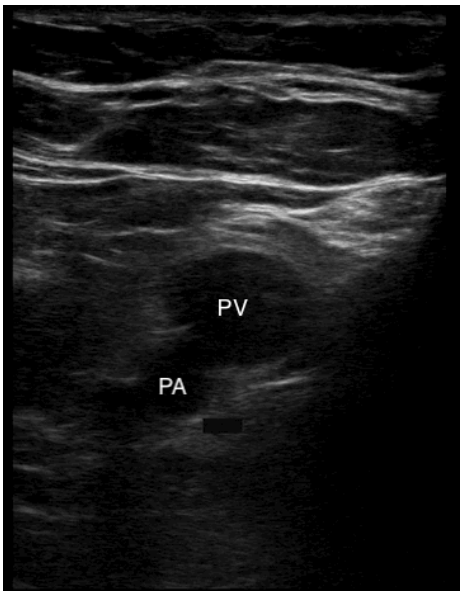
5. Adductor Canal Distal Femoral Vein

- This is immediately before the FV becomes the popliteal vein.
- It lies proximal and medial to the popliteal fossa.
- Challenging to obtain, the vein and artery should be **side by side**.
- Standardize your probe marker position (i.e. always pointing towards the right) to avoid confusion.



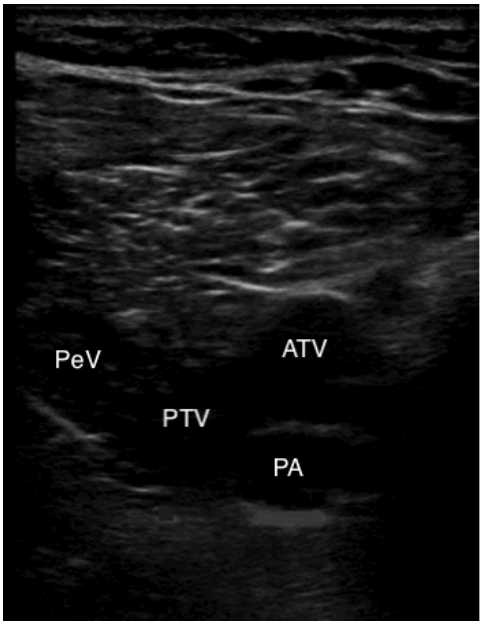
6. Popliteal Vein (PV) – Popliteal Fossa

- Place the probe directly between the two hamstring tendons behind the knee.
- The popliteal vein is superior to the artery, that is, "**pop on top**".



7. Popliteal Vein (PV) - Trifurcation

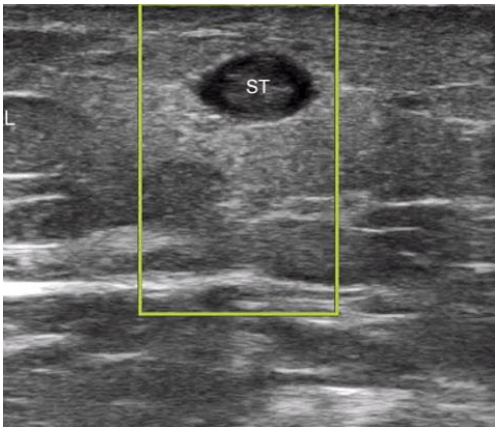
- Scan slightly distally to the popliteal fossa to find the trifurcation.
- This is division into the anterior tibial (ATV), posterior tibial (PTV), and peroneal veins (PeV), and marks the end of the exam.
- Note that for many patients, the three branches may not split simultaneously, but in quick succession. Occasionally, a second clip may be required.



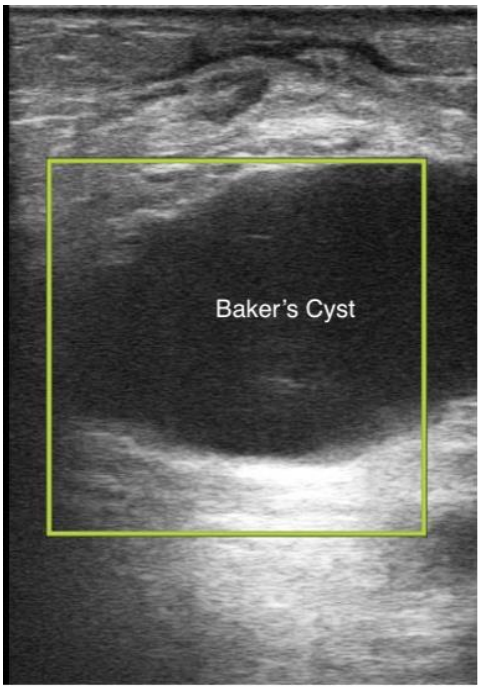
VI. FALSE POSITIVES[14]

1. Operator error – applying inadequate compression or pressure non-perpendicular to the vein leading to incomplete collapse.

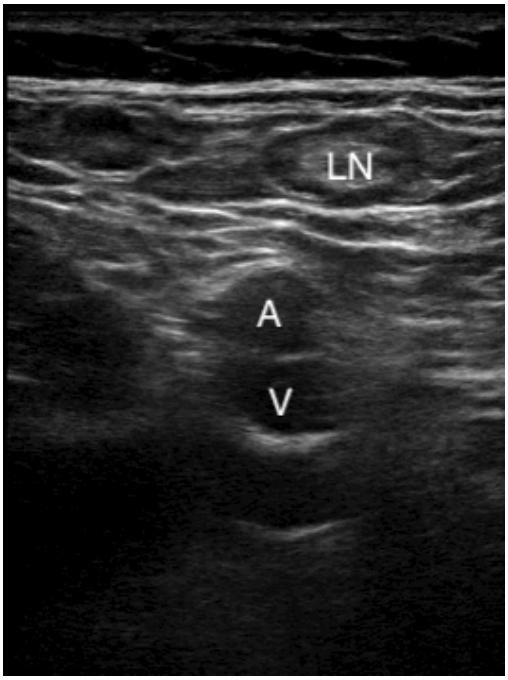
2. Superficial thrombophlebitis (ST) – common and can have overlying skin changes with associated sonographic subcutaneous tissue thickening with increased echogenicity. Note superficial veins lack adjacent arteries.



3. Baker's cyst. An enlarged, anechoic cystic structure in the popliteal fossa. Use **color doppler** to confirm the absence of color flow and vascularity. This should communicate with **the posterior knee joint** and typically has a neck or collar. Some say it looks like "**speaker's bubble**".



4. Lymph Nodes. Hypoechoic structure with a hyperechoic center, also separate from arteries and **will disappear fanning through**.



VII. CLINICAL INTEGRATION

Now that you have the **skills**, it's time to apply it to the patient in-front of you.

Like most tests in medicine, **pre-test probability is key.**

Consider the following diagram from **Rosen's Emergency Medicine 10th Edition**.[1]
Note: while Rosen's labels a three-point venous ultrasound, the two-zone DVT protocol described holds a greater sensitivity and can replace the three-point scan.

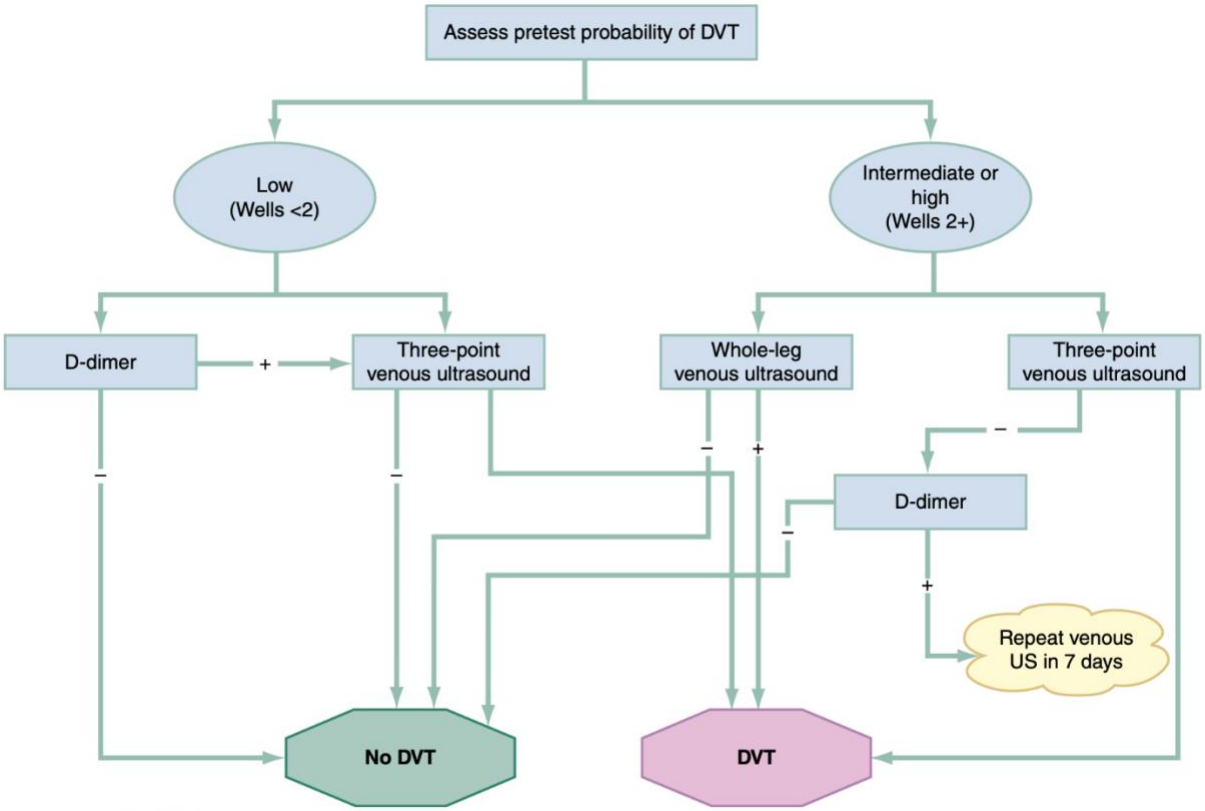


Fig. 74.6 Flowchart algorithm showing the diagnostic approach to a patient with possible acute deep vein thrombosis. *DVT*, Deep vein thrombosis; –, test negative; +, test positive; *US*, ultrasound.

Case 1: Low Pretest Probability

- A 20-year-old woman on oral contraceptives presents with unilateral leg pain and tenderness. Her **Wells DVT score is 1**, placing her in the **low-risk pre-test probability** category for DVT.
- While D-dimer testing could rule out DVT, her rural ED lacks lab access overnight. You perform a 2-zone DVT PoCUS and demonstrate full compressibility of all proximal veins.
- **Interpretation**: A negative scan effectively rules out proximal DVT. No further testing or treatment is required, and the patient can be safely discharged with a plan for follow-up for persistent symptoms.

Case 2: High Pretest Probability

- A 52-year-old man with metastatic lung cancer presents with left leg swelling and tenderness. His **Wells DVT score is 4**, with **high-risk pre-test probability.**
- On PoCUS, you find non-compressibility of the left common femoral vein,
- **Interpretation:** This a positive scan confirming the presence of a proximal DVT. The patient is started on anticoagulation immediately.
- If the scan had been negative, the next steps would depend on D-dimer results:
    - Negative D-dimer: Confirms the absence of DVT; the patient may be safely discharged.
    - Positive D-dimer: Indicates the need for follow-up imaging, typically a repeat ultrasound in one week, to rule out proximal extension of a distal DVT.[7]

Case 3: The Ambiguous Presentation

- A 70-year-old woman with obesity and recent surgery presents with bilateral leg swelling. Her **Wells DVT score is 2**, placing her in an **intermediate risk pre-test** probability category.
- PoCUS reveals compressibility of the proximal veins bilaterally but poor visualization of the popliteal trifurcation due to body habitus.
- **Interpretation:** The negative proximal scan reduces the likelihood of DVT, but the scan is ultimately indeterminate. Further evaluation with a radiology-performed duplex ultrasound is recommended.
- **Local practice considerations:** Management depends on urgency and outpatient follow-up availability. Some centers prioritize same-day formal ultrasound, while others may arrange next-day imaging or, if follow-up is readily available, consider empiric anticoagulation until further testing. Always follow local thrombosis protocols when determining next steps.

Case 4: The Shock of Unknown Cause Presentation

- 70-year-old male unwitnessed fall patient hypotensive and tachycardia.
- Initial history is limited. Patient arrests and is getting active CPR.
- Cardiac exam is technically very challenging with active CPR
- PoCUS of the right groin shows large uncompressible common femoral vein clot
- Interpretation: Hemodynamically unstable patient with large proximal DVT consideration for treatment of massive pulmonary emboli with TNK/TPA and activating local resources to consider thrombectomy or catheter directed TPA

Key Considerations

- POCUS is user and patient dependent so don't be afraid to call your scan indeterminate if you are not confident in your image generation or interpretation.
- Integrate PoCUS findings with the Wells score and D-dimer results when available.
- Use shared decision-making when considering distal DVTs or ambiguous cases, especially in patients at low risk for complications.
- Consider integrating DVT PoCUS in the poorly differentiated resuscitation patient.

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