Deep Vein Thrombosis (DVT): Diagnosis

Thrombosis Canada
Thrombose Canada

Objective:

To provide an evidence-based approach to the evaluation of patients with suspected acute deep vein thrombosis (DVT).

Background:

An estimated 45,000 patients in Canada are affected by DVT each year, with an incidence of approximately 1-2 cases per 1,000 persons annually. This translates into 2-4 DVTs per year in a typical, solo Canadian family practice. Since only 10-20% of patients with suspected DVT actually have the disease, a typical family practice will evaluate 20-40 patients with symptoms and/or signs suggestive of DVT each year.

The ability to rapidly and accurately assess patients for DVT is crucial. A validated diagnostic algorithm should be used in the evaluation of patients with suspected DVT. Treatment of DVT once diagnosed prevents thrombus extension and pulmonary embolism (PE) and initiation of anticoagulation should be considered prior to confirmation of DVT while awaiting diagnostic tests, unless contraindications exist [see **Clinical Guide** Deep Vein Thrombosis (DVT): Treatment]. The accurate exclusion of DVT eliminates unnecessary exposure to long term anticoagulants, which has treatment burdens and bleeding risks.

Anatomy:

The deep veins of the lower extremity are comprised of the proximal veins (popliteal, femoral, common femoral, external iliac) and distal veins (posterior tibial, anterior tibial, peroneal). This distinction is important as patients with distal DVT are at low risk of proximal extension and in some cases may not require anticoagulation therapy (see **Clinical Guide** Deep Vein Thrombosis (DVT): Treatment). Note as well that the superficial femoral vein, also known as the femoral vein, is in fact a deep vein and not a superficial vein. This has important therapeutic implications.

Diagnosis:

The diagnosis of DVT is based on:

1. Pre-test probability (clinical suspicion)

It is recommended that a validated clinical decision rule be used to characterize pre-test probability of DVT. There are several formal models available, of these, the Wells' Score is the most widely used (see **Table 1**). For DVT diagnosis, both a three-level (low, intermediate, high pre-test probability) and two-level (unlikely, likely) Wells' score have been prospectively validated inthe outpatient setting. The two-level score is displayed in the table and diagnostic algorithm below.

Table 1: Two-Level Wells Score for DVT Diagnosis

Clinical findings	Points
Paralysis, paresis or recent orthopedic casting of lower extremity	1
Bedridden >3 days recently or major surgery within past 12 weeks	1
Localized tenderness of the deep veins	1
Swelling of entire leg	1
Calf swelling 3 cm greater than other leg (measured 10 cm below the tibial tuberosity)	1
Pitting edema greater in the symptomatic leg	1
Non-varicose collateral superficial veins	1
Active cancer or cancer treated within 6 months	1
Previously documented DVT	1
Alternative diagnosis at least as likely as DVT (Baker's cyst, cellulitis, muscle damage, superficial vein thrombosis, post-thrombotic syndrome, inguinal lymphadenopathy, extrinsic venous compression)	-2

Wells' Score	Probability of DVT	Strata
<2	6%	Unlikely
≥2	28%	Likely

2. D-dimer

The D-dimer is a sensitive but non-specific marker of thrombosis. Although D-dimers are elevated in patients with DVT, they can also be elevated in a variety of other common conditions, including inflammatory diseases, malignancy, pregnancy, surgery, hospitalization, trauma, and advanced age. This renders the test useful to help rule out DVT when negative but of little diagnostic value when positive. Although there are several D-dimer assays available, those typically used in Canada are all highly sensitive assays with a sensitivity greater than 90%. When used in combination with an unlikely pre-test probability, a negative D-dimer can be used to exclude DVT without further imaging.

There is strong evidence for the use of a fixed, standard D-dimer threshold with validated clinical prediction rules to exclude DVT. There is also evidence for use of a probability-specific D-dimer threshold (i.e., cut off varying based on the pre-test probability) when using the three-level Wells' score. The use of an age-adjusted D-dimer threshold (i.e., cut off varying based on age) may also be considered. While there is a paucity of data for the use of age-adjusted D-dimer testing for DVT, recent evidence suggests that this may be safe.

Community-based physicians are unlikely to receive timely D-dimer results from outside laboratories and therefore may not be able to use strategies involving sequential tests. Alternative management approaches include diagnostic algorithms incorporating pre-test probability assessment and compression ultrasound

(CUS, outlined below). In some centres, the option of referring patients to a Thrombosis Clinic may be available to facilitate rapid assessment.

3. Venous Compression Unltrasound

Compression ultrasound (CUS) examines the compressibility of the veins. Failure to demonstrate full compressibility of a vein in a patient without prior DVT is highly suggestive of DVT. CUS can be done of the whole leg (distal and proximal veins) or limited to the more clinically significant proximal (femoral and popliteal) veins. Because distal thrombosis may extend proximally in ~20% of cases, an initial negative proximal CUS should be repeated within 5-7 days in patients with a high/likely clinical suspicion of DVT and a D-dimer above the positivity threshold. Alternatively, patients and clinicians may prefer to perform a whole leg CUS in patients with high/likely clinical suspicion. The advantage to whole leg CUS is that if negative, repeat serial CUS are not needed. The disadvantage of whole leg CUS is the overdiagnosis of isolated distal (calf) DVT that may lead to some uncertainty about management (i.e., whether to treat or to perform serial CUS to look for extension) [see Clinical Guide Deep Vein Thrombosis (DVT): Treatment]. International guidelines and consensus statements vary on the recommendation for proximal CUS over whole leg CUS. Most recommend against distal vein imaging (reducing overdiagnosis of distal DVT), but others suggest whole leg CUS (reducing follow up CUS) with option of serial CUS or treatment for the distal DVTs identified.

Diagnostic Strategy:

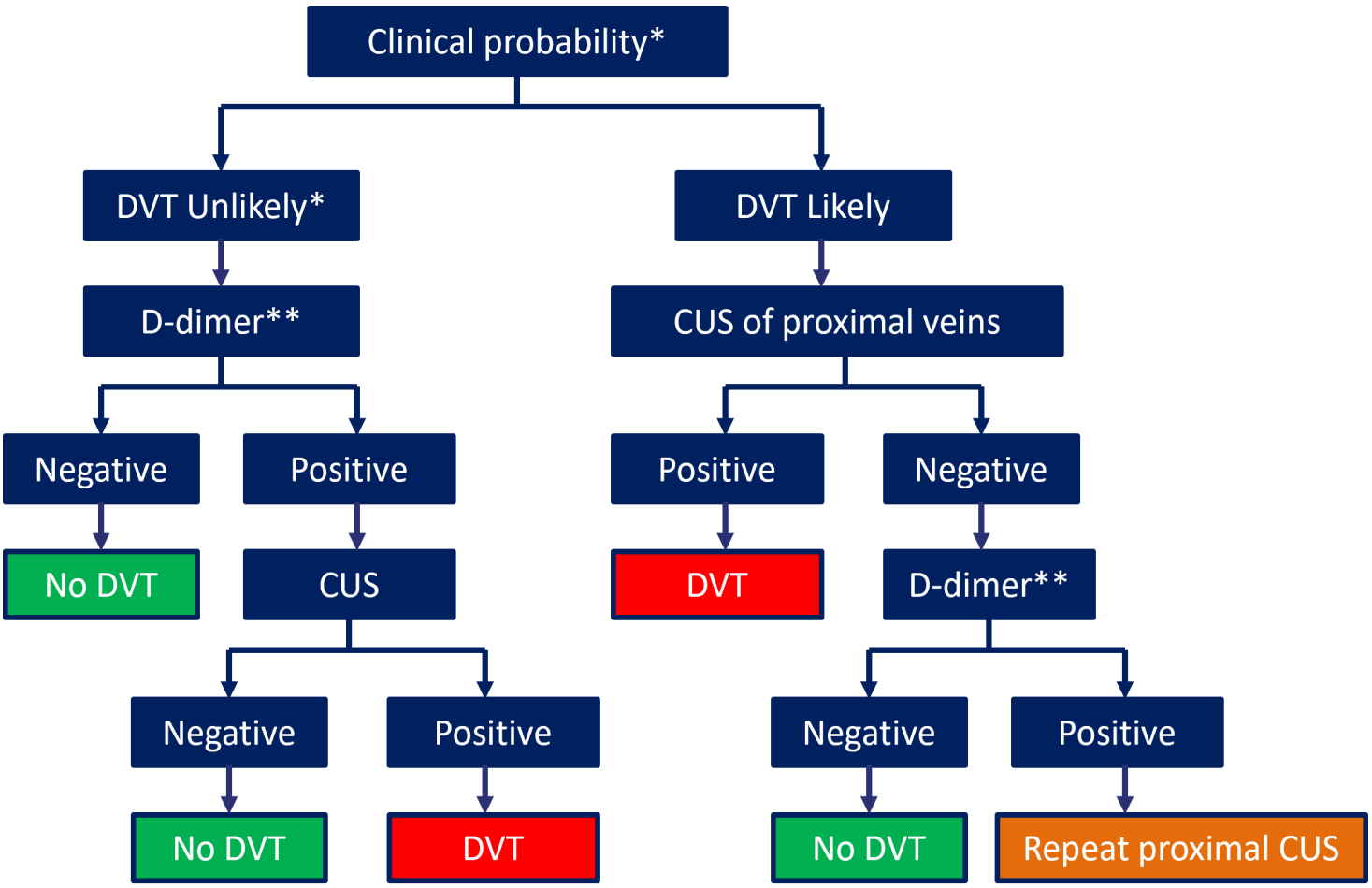
Patients with suspected DVT should first undergo a history and physical exam focused on the components of the Wells' Score, as well as symptoms and signs of PE [see **Clinical Guide** **Pulmonary Embolism (PE) Diagnosis**].

- Patients with an unlikely PTP for DVT should then undergo D-dimer testing with management as outlined in **Figure 1** below.
- Patients with a likely PTP should have either a proximal CUS or whole leg CUS as the recommended first-line test. Those with a negative proximal CUS should undergo D-dimer testing (to determine the need for repeat CUS) and repeat proximal CUS in 5-7 days to exclude the possibility of distal DVT that has extended proximally. Those with a negative whole leg CUS do not require D-dimer or repeat CUS.

In jurisdictions where proximal CUS is readily available in a timely manner and where D-dimer turnaround times are long, proceeding directly to proximal CUS for all patients suspected of a DVT is a reasonable but more costly strategy. With this approach, a negative proximal CUS and unlikely pre-test probability excludes DVT, while patients with a likely pre-test probability and negative proximal CUS should have CUS repeated in 5-7 days.

If whole leg CUS is undertaken and isolated distal DVT is detected, anticoagulation can be offered if severe symptoms are present or if the risk of proximal extension is high [see **Clinical Guide** **Deep Vein Thrombosis (DVT): Treatment**]. Alternatively, patients may be followed with serial CUS over a 1-2 week period, after which time thrombus extension is unlikely. Those unlikely or unable to return for follow-up testing should generally be treated. Risk factors for proximal extension of a distal DVT include: positive D-dimer, calf DVT that is extensive or close to the proximal veins, absence of a reversible provoking risk factor, cancer, previous history of venous thromboembolism, lower extremity immobilization (e.g. plaster casting, neuromuscular disease), and in-patient status.

Figure 1. Suggested diagnostic strategy for patients with suspected DVT.



*Clinical probability can be assessed by clinical decision rule, such as two-level Wells' score.
**D-dimer should be measured using a highly sensitive assay to rule out DVT using this algorithm; if D-dimer testing is not available, CUS should be performed in all patients; a negative CUS and unlikely pre-test probability excludes DVT, while patients with a likely pre-test probability and negative CUS should have CUS repeated in 5-7 days.

Special Considerations:

Timing of diagnostic testing:

Testing should be undertaken as quickly as possible. However, if there will be a significant delay (greater than 4 hours), patients with a moderate/high or likely pre-test probability of DVT should receive a rapidly acting anticoagulant (e.g. low-molecular-weight heparin or a direct oral anticoagulant) until testing is performed, unless they are at high risk of bleeding or have a contraindication to anticoagulant therapy.

Suspected recurrent DVT:

In the case of suspected recurrent ipsilateral DVT, CUS can be problematic because residual compression abnormalities are often present from the previous DVT. In such cases, it is important to compare CUS results with those from prior examinations. Recurrent DVT can only be definitively diagnosed with evidence of new thrombosis, including non-compressibility in previously normal venous segments or increases of at least 4 mm in compression diameter from prior studies. A negative D-dimer may make the diagnosis of recurrence less likely and may be helpful when no prior CUS studies are available for comparison. Consultation with an

expert in the field may be helpful in this setting and particularly when no prior CUS is available for comparison.

Upper extremity DVT (UEDVT):

[See also **Clinical Guide** Central Venous Catheter-Related Deep Vein Thrombosis]

UEDVT is uncommon with an annual incidence of approximately 3/100,000 persons. Most patients with UEDVT have risk factors including central venous catheter, recent pacemaker or malignancy. Spontaneous UEDVT is often related to sudden physical effort and narrowing of the thoracic outlet (Paget-Schroetter syndrome, thoracic outlet syndrome). Clinical manifestations include acute and chronic arm pain, swelling, discoloration, and dilated collateral veins over the arm, neck or upper chest.

Pre-test probability for UEDVT is typically determined by clinical gestalt. The Constans Decision Score (which includes central venous catheter or pacemaker, localized pain, or unilateral edema) has also been shown to safely exclude UEDVT when used in combination with high-sensitivity D-dimer. However, this approach has had only limited validation in one prospective management study. In general, combined CUS and color Doppler flow studies (duplex ultrasound) generally are used to evaluate patients with suspected UEDVT:

- In patients with **low/unlikely** pre-test probability, a strategy starting with D-dimer is suggested, followed by duplex ultrasound if D-dimer is positive. If D-dimer is not readily available, performing duplex ultrasound alone is acceptable.
- In patients with **high/likely** pre-test probability, duplex ultrasound should be performed to exclude UEDVT. If the initial US is negative, the diagnosis can be considered excluded unless the clinical suspicion remains high. In that case, further testing with D-dimer (with additional imaging if positive), repeat ultrasound, or traditional contrast venography, CT venography, or MRI is suggested.

Pediatrics:

The incidence of DVT in children is lower than adults (0.7 to 0.14 per 10,000 children) and when it does occur it is more often associated with or use of central venous catheters, a primary disease (such as cancer and congenital heart disease), or after intervention. The use of clinical decision rules and D-dimer testing has not been validated in children. Diagnosis of DVT is initiated with a CUS. While CUS testing is non-invasive, it may not be accurate for the upper extremity venous system and there have been few studies in the lower venous system. If the clinical suspicion is high for DVT with a negative CUS, the use of magnetic resonance imaging or computed tomography may be considered.

Suspected DVT in pregnancy:

See **Clinical Guide** Pregnancy: Diagnosis of DVT and PE.

Other Relevant Thrombosis Canada Clinical Guides:

- Central Venous Catheter-Related Venous Thrombosis
- Deep Venous Thrombosis (DVT): Treatment
- Pregnancy: Diagnosis of DVT and PE
- Pulmonary Embolism (PE): Diagnosis

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