Deep vein thrombosis (DVT) is a common disorder that may be difficult to diagnose clinically (accuracy: 58%—70%) but carries significant morbidity and mortality if unrecognized or untreated.1 Because there is a high incidence of lower-extremity DVT (70%—75%) in patients with arteriographically documented pulmonary emboli (PE),2,3 early detection of DVT is of significant value to decrease the risk of life-threatening PE. Clinical diagnosis of lower-extremity DVT requires confirmation by imaging study before committing the patient to anticoagulation therapy. Ultrasonography (US) is currently the principal imaging technique used for the detection of venous thrombosis in the extremities.4 Studies have shown that demonstrating compressibility of leg veins under US is accurate for ruling out DVT when performed by vascular imaging specialists.

Some other methods have been used for the detection or diagnosis of DVT, including plethysmography, Tc-labeled fibrinogen scintigraphy, D-dimer assay, and contrast venography. Contrast venography, once the diagnostic test of choice for lower-extremity DVT, has been considered the gold standard; but because it is invasive, expensive, or may be technically incomplete or uninterpretable, and can occasionally induce venous thrombosis, it is not an optimal screening technique for detecting DVT and has been largely replaced by lower-extremity duplex US in recent years.5 US, with its noninvasive nature, high availability, ease of performance, and high accuracy in diagnosis, has been chosen as the initial study in the evaluation of suspected DVT in the last two decades.1 This noninvasive diagnostic method approaches contrast venography in accuracy for diagnosis of proximal lower-extremity DVT. However, it falter when calf venous thrombosis is present, showing a sensitivity of approximately 40%—70%.6 Standard lower-extremity duplex US guidelines have included repeat examinations at Day 1 and 3—7 days after a normal study.7,8 This protocol was initiated to catch the 20% of calf thrombi that will propagate proximally. Some recent studies have indicated that one repeat examination at 5—7 days after an initial negative result may be necessary to ensure a more accurate diagnosis.6

Although lower-extremity duplex US has become the preferred test for diagnosing DVTs, it is not always available around the clock. Many emergency departments have no access to vascular studies during off hours and are forced to admit even relatively low-risk patients suspected of having lower-extremity DVTs. These patients are usually started on heparin and await a lower-extremity duplex US study the following morning. Hospitalizing a patient to await a duplex US examination apparently incurs a tremendous cost. In addition, initiation of anticoagulant therapy before diagnostic testing the following day might create false-negative studies in some patients. Some emergency physicians (EPs) now send such patients home on low-molecular-weight heparin to return for an outpatient study the next morning. This approach may be less costly, but both strategies place the patient at a certain risk for bleeding complications.5 The EPs bear a large burden to accurately diagnose patients with DVTs. Recent studies show that more and more EPs are forced to explore bedside US for the detection of DVT in the emergency departments. Jolly et al retrospectively evaluated the ability of two EPs to perform lower-extremity duplex US examinations after being trained in the vascular laboratory.9 A sensitivity of 100% and specificity of 75% were achieved, although more examination time was needed.9,10

To test a simplified approach, Frazee et al11 performed bedside lower-extremity US examinations in their emergency departments. Vein compressibility was assessed at the common femoral and popliteal veins. The study showed a specificity of 93% and a sensitivity of 74%, with a negative predictive value of 97% and positive predictive value of 50%.11 This simplified approach has been documented to be effective and safe.5,7 Theodoro et al12 conducted a study to compare the time to disposition between the EP-performed lower-extremity US and that performed by imaging specialists. They found that the mean time from triage to EP disposition was 95 minutes and mean time from triage to radiology disposition was 220 minutes. The difference of 125 minutes was statistically significant (p < 0.0001). EPs and imaging specialists had excellent agreement (kappa = 0.9). Compression ultrasound performed by EPs resulted in a significant decreased time to disposition.12 All evidence showed that properly trained EPs are able to accurately detect proximal DVTs and can provide adequate diagnostic information in a timely manner with US examination at the bedside. EPs can decrease the time to disposition decision when performing their own lower-extremity US examinations.

The diagnostic accuracy of US for DVT varies according to the technique used. The optimal sensitivity for identifying proximal DVT can be quite similar, that is, 96%, 96%, and 94% by using duplex US, triplex US, and compression US, respectively; the
specificity is also high, up to 94%, 94%, and 98%, respectively.\textsuperscript{13} These findings suggest that compression US alone is an appropriate technique in the evaluation of proximal DVT for most patients. A highest sensitivity (75%) for identifying distal DVT can be achieved by using triplex US, whereas duplex and compression US can achieve sensitivities of 71% and 57%, respectively.\textsuperscript{13} Calf DVTs are best assessed by using triplex US, however, calf vein thrombosis does not present the risk associated with proximal thrombosis; propagating to the proximal veins, it would be caught on follow-up studies that need to be done in 5−7 days. Compression US is considered the most time-saving and practical technique in identifying DVT. Busy EPs can be easily trained with adequate skill.\textsuperscript{14}

In a recent issue of the Journal of the Chinese Medical Association, Tsao et al\textsuperscript{15} reported their retrospective study that investigated the value of “noncompressibility ratio” of thrombosed veins in 34 adult DVT patients. They found that noncompressibility ratio was significantly higher in patients with both popliteal and femoral vein thrombosis (Group I) than in those with isolated popliteal vein thrombosis (Group II) (p < 0.05), and the clinical prognostic score of Group I was significantly higher than that of Group II (p < 0.05). A significant positive correlation between noncompressibility ratio of the thrombosed vein and the clinical prognostic score (p = 0.001) was also noted. Based on my personal observations, I presume that the mechanism of increased clinical prognostic score and higher noncompressibility ratio in Group I patients could be related to the age of the thrombus. However, the age of the thrombus was not analyzed in this article. Based on the venographic study of 166 patients with symptomatic proximal DVT, Cogo et al\textsuperscript{16} noticed that the distribution of clot within the proximal venous system of lower extremities was as follows: popliteal only, 10%; popliteal and superficial femoral, 42%; popliteal, superficial and common femoral, 5%; all proximal veins, 35%; and common femoral with or without superficial or iliac veins, 8%. Doyle et al\textsuperscript{17} reported that calf DVTs propagate proximally into the popliteal vein and thigh in about 20% of cases. These findings suggest that proximal DVT may originate from the veins of the calf or popliteal region. Most lower-extremity thrombi form around the valve cusps in small calf veins. Nevertheless, the fact that involvement of the femoral vein bears higher risk to develop PE has been confirmed by Doyle’s study.

Regardless of the age of a thrombus, on the basis of a study by Tsao et al.,\textsuperscript{15} the diseased veins showing higher noncompressibility ratio have a higher clinical prognostic score in patients in emergency departments. This finding suggests that noncompressibility ratio can be an important new parameter in US evaluation of DVT if a subsequent larger series study can be conducted to confirm this result. Those with higher noncompressibility index (i.e. at an increased risk) might not be suggested to have treatment at home. They are potentially eligible for hospitalization, and proper therapy should be started for their acute symptomatic DVT of the lower extremities.

References