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A Comparison of the Accuracy of the Kagoshima Score and the Wells Score in Predicting Suprainguinal Deep Vein Thrombosis at Dr. Cipto Mangunkusumo National General Hospital

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ABSTRACT
Suprainguinal deep vein thrombosis (DVT) is a thrombotic condition associated with serious complications, including pulmonary embolism and post-thrombotic syndrome. The clinical manifestations of suprainguinal DVT are often nonspecific, making early diagnosis challenging, particularly in healthcare facilities with limited access to vascular imaging modalities. The Wells Score and Kagoshima Score are clinical prediction tools used to estimate the likelihood of DVT; however, their diagnostic performance in suprainguinal DVT has not been extensively evaluated. This retrospective study used medical records of patients with CTA-confirmed suprainguinal DVT at Dr. Cipto Mangunkusumo National General Hospital. The collected data included demographic characteristics, thrombotic risk factors, clinical manifestations, Wells Score, and Kagoshima Score results. Analyses were performed to evaluate the sensitivity of both scoring systems and identify factors associated with false-negative classifications.A total of 47 patients with CTA-confirmed suprainguinal DVT were included in this study. Most participants were female, with a mean age above 50 years. The most common clinical manifestation was lower extremity edema (95.7%), followed by superficial venous dilatation and lower extremity pain. The Kagoshima Score demonstrated a sensitivity of 91.5%, whereas the Wells Score showed a sensitivity of 89.4%. Bivariate analysis revealed that younger age and absence of a cancer history were significantly associated with false-negative classifications in both scoring systems. In addition, lower body mass index (BMI) was associated with false-negative classifications in the Wells Score. All patients with a history of malignancy were classified as high-risk by both scoring systems. The Kagoshima Score and Wells Score demonstrated high sensitivity for detecting confirmed suprainguinal DVT, with the Kagoshima Score showing slightly higher sensitivity than the Wells Score.

INTRODUCTION

Deep vein thrombosis (DVT) is an obstructive vascular condition caused by thrombus formation within the deep venous system, particularly in the lower extremities. Thrombus formation generally begins in the lower limb veins and may extend proximally to the femoral veins, iliac veins, and even the inferior vena cava. DVT is part of the venous thromboembolism (VTE) spectrum and is considered one of the leading causes of cardiovascular-related mortality after myocardial infarction and stroke. DVT represents a significant health burden, with an estimated annual incidence of approximately 80 cases per 100,000 individuals and a prevalence of approximately 1 case per 1,000 individuals. In the United States, more than 200,000 individuals are diagnosed with venous thrombosis annually, with approximately 50,000 developing pulmonary embolism complications. Meanwhile, a prospective study from the IDENTIA registry involving high-risk inpatients reported a DVT incidence of 6.5%. However, specific epidemiological data regarding the prevalence of suprainguinal DVT in Indonesia remain unavailable (Ciccotosto et al., 2002; Huang et al., 2022; Sarshar et al., 2025; Stubbs et al., 2018; Tambunan et al., 2020; Waheed et al., 2023).

Based on anatomical location, DVT can be classified into distal, femoropopliteal, and suprainguinal DVT. The anatomical location of thrombus formation plays an important role in determining the risk of pulmonary embolism (PE); the more proximal the thrombus location, the greater the potential risk of embolization to the pulmonary circulation. Suprainguinal DVT, which includes thrombosis of the iliac veins and inferior vena cava, represents a more challenging form of DVT to diagnose, primarily due to limitations of imaging modalities such as ultrasonography in evaluating the pelvic and lower abdominal regions (Bagot & Arya, 2008; Grigorian & Nahmias, 2023; Hamamoto et al., 2022; Kumar et al., 2010; McLendon et al., 2021; Modi et al., 2016).

The diagnosis of suprainguinal DVT is challenging because its clinical manifestations are often nonspecific and may overlap with other conditions. Furthermore, commonly used imaging modalities, such as ultrasonography, have limitations in evaluating the iliac veins and inferior vena cava due to their deep anatomical locations. Computed tomography angiography (CTA) provides greater accuracy for detecting suprainguinal thrombus; however, its availability remains limited in some healthcare facilities, particularly those with constrained resources. In addition, CTA requires contrast administration, involves radiation exposure, and may increase healthcare costs (Branchford & Carpenter, 2018; Langford et al., 2012; Naringrekar et al., 2019; Stone et al., 2017; "Virchow's Triad and Deep Vein Thrombosis (DVT)," 2025).

Under these circumstances, a simple, rapid, and accessible clinical approach is required to improve the pretest probability of DVT before definitive imaging evaluation. The Wells Score is currently one of the most widely used clinical prediction tools for estimating DVT probability based on a combination of clinical findings and risk factors. It is commonly applied as an initial risk stratification method to determine the need for further diagnostic evaluation and guide early management decisions in patients with suspected DVT (Goodacre et al., 2005; Guyatt et al., 2012; Kearon et al., 1998; Min et al., 2016).

In contrast, the Kagoshima Score is a relatively newer clinical scoring system that incorporates objective clinical and laboratory parameters, including age, body mass index (BMI), immobilization, cancer history, leg pain, and D-dimer levels. The Kagoshima Score was developed to improve DVT detection, particularly in Asian populations, and has demonstrated favorable diagnostic performance in previous studies. Its objective assessment approach may provide additional value in identifying patients with complex thrombotic risk profiles (Kakkos et al., 2021; Lewis et al., 2019; Rabinov & Paulin, 1972; Stevens et al., 2021).

Although both scoring systems have been applied in clinical practice, studies directly comparing the Wells Score and Kagoshima Score in patients with suprainguinal DVT remain limited. Suprainguinal DVT has distinct clinical characteristics and a different risk profile for pulmonary embolism compared with distal and femoropopliteal DVT. This evidence gap is important because suprainguinal DVT is associated with a higher risk of embolization and may require more intensive management, while available clinical prediction tools have not been adequately validated in this specific population.

The importance of this study is supported by the increased risk of pulmonary embolism and post-thrombotic syndrome associated with suprainguinal DVT compared with distal DVT. Despite these risks, suprainguinal DVT may remain underdiagnosed due to nonspecific clinical presentations and limited access to advanced vascular imaging. Therefore, evaluating the performance of clinical scoring systems in detecting suprainguinal DVT may assist in earlier identification of high-risk patients and support timely clinical management, particularly in healthcare settings with limited imaging resources.

The novelty of this study lies in its focus on a specific anatomical subtype of DVT, namely suprainguinal DVT, which has been underrepresented in previous validation studies of clinical prediction tools. Unlike previous studies evaluating the Wells Score or Kagoshima Score in general DVT populations, this study specifically assessed their performance in patients with CTA-confirmed suprainguinal DVT. Furthermore, identifying factors associated with false-negative classifications may provide additional clinical insights for interpreting these scoring systems in specific patient subgroups.

Therefore, this study was conducted to evaluate the clinical characteristics of patients with suprainguinal DVT and compare the performance of the Wells Score and Kagoshima Score in predicting suprainguinal DVT based on CTA-confirmed diagnosis. The findings are expected to support clinical decision-making, prioritization of diagnostic evaluation, and timely management strategies for patients with suspected suprainguinal DVT, particularly in healthcare facilities with limited access to advanced vascular imaging modalities.

METHOD

This retrospective cohort study used an analytical descriptive approach and was conducted at Dr. Cipto Mangunkusumo National Hospital, Jakarta, from November 2025 to April 2026. The study included adult patients (≥18 years) with CTA-confirmed suprainguinal DVT who had complete initial clinical data and available Wells Score and Kagoshima Score assessments. Samples were obtained using total sampling based on the inclusion and exclusion criteria. Exclusion criteria included incomplete medical records, infrainguinal vein thrombosis, other diagnoses that could significantly affect score interpretation, and a history of anticoagulant use for more than 72 hours before examination. The minimum sample size was calculated based on sensitivity estimates from previous studies, resulting in 47 subjects for Kagoshima Score validation and 42 subjects for Wells Score validation; therefore, a minimum sample size of 47 subjects was used in this study.

Data were collected from medical records, ultrasound and CTA radiology reports, and initial clinical assessments, including lower extremity pain, unilateral or bilateral edema, skin discoloration, superficial collateral veins, and systemic symptoms associated with pulmonary embolism. The independent variables were Wells Score, Kagoshima Score, and clinical findings, while the dependent variable was CTA-confirmed suprainguinal DVT. Age, sex, body mass index (BMI), and comorbidities were analyzed as potential confounding variables. Data were recorded using Microsoft Excel 2016 for Windows and analyzed using SPSS version 29 for Windows.

Univariate analysis was performed to describe demographic and clinical characteristics. Numerical data distribution was assessed using the Kolmogorov–Smirnov normality test and presented as mean ± standard deviation or median with interquartile range, while categorical variables were presented as frequencies and percentages. Bivariate analysis was conducted to identify factors associated with the accuracy of the Wells Score and Kagoshima Score in predicting suprainguinal DVT using the independent t-test for normally distributed numerical variables and the chi-square test for categorical variables.

This study received ethical approval from the Ethics Committee of the Faculty of Medicine, Universitas Indonesia–Dr. Cipto Mangunkusumo National Hospital, under approval number KET 228/UN2.F1/ETIK/PPM.00.02/2026. All data collection procedures were conducted after ethical approval was obtained, while maintaining the principles of autonomy, beneficence, confidentiality, non-maleficence, equality, and justice.

RESULT AND DISCUSSION

Characteristics of Research Subjects

This study involved 47 subjects who all met the inclusion and exclusion criteria, with good data completeness on all variables studied. All subjects in this study were confirmed to have suprainguinal DVT based on CTA examination, so there was no control group in the study population. Meanwhile, an infrainguinal ultrasound examination has confirmed the absence of an infrainguinal thrombus.

Based on demographic characteristics, the average age of the subjects was 54.72 ± 15.81 years, with an age range between 24 and 83 years. This distribution suggests that suprainguinal DVT can occur in a variety of age groups, although it is more commonly found in adulthood to advanced age. The median age of 57 years shows a tendency to distribute towards the older age group.

By gender, most of the subjects were female (59.6%), while men were 40.4%. This distribution suggests the predominance of female patients in the study population, which may be related to certain risk factors such as hormonal conditions or comorbidities.

Body mass index (BMI) values showed an average of 24.05 ± 5.99 kg/m², with a fairly wide range of values (12.4–36.5 kg/m²), reflecting variations in nutritional status in the study population.

In terms of risk factors, most of the subjects did not experience immobilization (72.3%), but the proportion of patients with a history of cancer was quite high (61.7%), which suggests that malignant hypercoagulability is the dominant risk factor in this population.

Table 1 Demographic Characteristics and Risk Factors of Subjects

Variabel	n (%) / Mean ± SD
Number of subjects	47
Age (years)	54.72 ± 15.81
Gender	
Women	28 (59,6%)
Male	19 (40,4%)
BMI (kg/m²)	24.05 ± 5.99
Immobilization	
Yes	13 (27,7%)
No	34 (72,3%)
A history of cancer	
Yes	29 (61,7%)

No	18 (38,3%)
Infrainguinal Trombus (ultrasound examination)	
There	0 (0%)
None	47 (100%)

The findings of this study are in line with findings by Shibata et al., which showed that the risk of cancer-associated thrombosis increased significantly in patients with a high Kagoshima score, with an incidence reaching more than 30% in the medium to high risk group. The study also emphasized the importance of integrating clinical risk factors and biomarkers such as D-dimers in improving the accuracy of thrombosis predictions.40

In addition, advanced age also plays an important role in increasing the risk of DVT through various mechanisms, including decreased fibrinolytic function and increased coagulation activity. In a study by Y. Hamamoto et al., age ≥60 years was one of the important components of the Kagoshima Score and was shown to be associated with an increased incidence of DVT in the perioperative population.41

The dominance of female patients in this study is also interesting to observe. Although not further analyzed in this study, hormonal factors, estrogen therapy, as well as specific conditions such as pregnancy and postpartum are known to contribute to an increased risk of thrombosis. Overall, the characteristics of the subjects in this study suggest that the population studied is not a general population, but rather a population with a high clinical probability of DVT, which has important implications for the interpretation of diagnostic analysis results.

Clinical Characteristics of Patients

Analysis of clinical manifestations shows that leg edema is the most dominant symptom, found in 95.7% of patients. These findings confirm that edema is a major manifestation in suprainguinal DVT, which is related to increased venous pressure due to obstruction of venous backflow in the proximal venous system. In DVT involving the iliac vein or inferior vena cava, disruption of venous flow can lead to a wide increase in hydrostatic pressure, so the edema that occurs tends to be more severe and involves the entire lower extremities.

In addition to edema, superficial venous dilatation was found in 53.2% of patients, reflecting the existence of a compensatory mechanism in the form of the formation of collateral circulation. This collateral formation is a physiological response to obstruction of the main venous flow, and may indicate that the thrombosis process has taken place in the subacute to chronic period.

Lower extremity pain was found in 44.7% of patients, suggesting that although pain is one of the classic symptoms of DVT, not all patients experience it. This suggests that DVT, particularly at suprainguinal locations, can have clinical manifestations that are not always typical, so symptom-based diagnosis alone is not enough.

Systemic symptoms, such as shortness of breath or chest pain, were found in 40.4% of patients, which may indicate the possibility of complications in the form of pulmonary embolism. Given that proximal DVT has a higher risk of embolization than distal DVT, these findings confirm the importance of clinical vigilance against possible complications.

Meanwhile, skin discoloration was found in 21.3% of patients, which is relatively rarer than other symptoms. This suggests that skin discoloration is not the main manifestation, and is likely to appear more often in more severe or advanced conditions.42

Table 2 Characteristics of Clinical Symptoms

Clinical Symptoms	n (%)
Limb edema	45 (95,7%)
Lower extremity pain	21 (44,7%)
Superficial venous dilation	25 (53,2%)
Systemic symptoms	19 (40,4%)
Skin discoloration	10 (21,3%)

Wells and Kagoshima Clinical Score Distribution

The distribution of clinical scores showed that most of the patients in the study were classified as high-risk by both scoring systems used. Based on the Wells Score, as many as 42 patients (89.4%) were included in the high-risk category, while 5 patients (10.6%) were included in the low-risk category. This shows that the majority of patients already have a high clinical probability of DVT based on the parameters used in the Wells Score.

In the Kagoshima Score, 43 patients (91.5%) were included in the high-risk category, while 4 patients (8.5%) were included in the low-risk category. In addition, when viewed by complete categories, most patients are in the medium to high risk group.

This distribution suggests that both scores have a tendency to classify a large proportion of patients as high-risk in the population with confirmed DVT. This reflects that in populations with a high probability of disease, clinical scores tend to have good detection capabilities, but their potential for discriminating capabilities is limited.

Table 3 Wells Score Distribution

Category	n (%)
Low	5 (10,6%)
Height	42 (89,4%)

These findings are in line with a study by Jean-Eudes Trihan et al., which showed that the Wells Score had limited performance in the inpatient population, especially in those who received thromboprophylaxis. The study reported that the Wells Score had discriminatory abilities that varied depending on the patient's clinical condition.33

In addition, research by Rolf P Engelberger et al. also showed that the Wells Score is not optimal in some populations, particularly inpatients and distal DVT cases.43 This suggests that the Wells Score has limitations in certain contexts. However, in a study by Shrey Modi et al., the Wells Score showed excellent performance (AUC 0.859), which confirms that the validity of this score is highly dependent on the population studied.7

Table 4 Distribusi Kagoshima Score

Category	n (%)
Low	4 (8,5%)
Medium	27 (57,4%)
Height	16 (34,0%)

These findings are interesting when compared to a prospective validation study by Y. Hamamoto et al., which showed that the Kagoshima Score was able to effectively stratify the risk of DVT, with the prevalence of DVT increasing significantly as scores increased (32% in the intermediate group and 54.7% in the high risk group). This shows that in this population, the Kagoshima Score has a good discriminatory value.41

This difference in results is likely due to several key factors. First, the population of Hamamoto et al.'s study had a more balanced risk distribution, whereas in this study, almost all patients had experienced DVT (96%). This condition causes the discriminatory ability of the score to decrease due to the lack of variation in outcomes.41

Second, key components of the Kagoshima Score, such as D-dimer, age, and clinical risk factors, may lose their discriminating ability in high-prevalence populations, where almost all patients have abnormal scores. In addition, an AUC value of 0.375 indicates that this score is not only inaccurate, but also incapable of meaningfully distinguishing patients with and without DVT. This may indicate a misclassification or data distribution bias, which will be discussed further.41

Bivariate Analysis of Factors Affecting Wells Score Results

Table 5 Bivariate Analysis of Factors Related to Wells Score Prediction Errors

Variabel	Correct Prediction	Wrong Prediction	p-value
Age (years)	56,52 ± 14,67	39,60 ± 18,66	0,022*
BMI (kg/m²)	24,64 ± 5,90	19,05 ± 4,55	0,047*
Gender			1,000**
Women	25 (89,3%)	3 (10,7%)	
Male	17 (89,5%)	2 (10,5%)	
Immobilization			0,303**
Ya	13 (100%)	0 (0%)	
No	29 (85,3%)	5 (14,7%)	
History of Cancer			0,006**
Ya	29 (100%)	0 (0%)	
No	13 (72,2%)	5 (27,8%)	

Remarks: The prediction is correct if the Well score is obtained with a high risk of DVT and is confirmed to be positive for CTA. Prediction is wrong if the Well score is obtained with a low risk DVT but confirmed positive CTA.

*Independent t-test

**Fisher Exact Test

Bivariate analysis was performed to evaluate factors associated with Wells Score prediction errors in patients with confirmed suprainguinal DVT. In this study, correct prediction was defined as a patient with confirmed DVT based on a CTA classified as high-risk DVT by the Wells Score. Meanwhile, the wrong prediction is if the Well score is obtained with a low risk of DVT but is confirmed to be positive for CTA.

Patients with a false negative Wells Score have a younger average age than patients who are successfully detected as high risk. This suggests that Wells Score tends to have better sensitivity in the elderly age group. Clinically, these findings can be explained because old age is closely related to an increased risk of thrombosis through various mechanisms, such as endothelial dysfunction, increased coagulation activity, decreased fibrinolytic activity, as well as increased comorbidities that contribute to the hypercoagulabeled state. Elderly patients also tend to have clearer clinical manifestations and risk factors, making it easier to meet the components in the Wells Score.

In contrast, younger patients may have milder clinical manifestations or less prominent risk factors, resulting in a lower clinical score even though the patient has experienced suprainguinal DVT. These findings suggest that the use of Wells Score in young patients needs to be done with caution, as there is a possibility of underestimation of the risk of DVT.

In addition to age, BMI also showed a meaningful relationship with Wells Score prediction errors. Patients with false negatives had a lower average BMI than the group that was successfully detected. This suggests that Wells Score tends to be more sensitive in patients with higher BMIs. Theoretically, patients with a higher BMI generally have a greater thrombotic risk due to chronic inflammation, increased venous stasis, as well as hemodynamic changes that contribute to thrombus formation. In addition, patients with low BMI may have more subtle manifestations of edema or clinical changes, so the clinical component in the Wells Score becomes less prominent.

History of cancer also shows a very meaningful relationship with Wells Score performance. All patients with a history of cancer in this study were successfully classified as high risk by the Wells Score, while false negatives were only found in patients without a history of cancer. These findings confirm that malignant conditions are a very strong factor in increasing the sensitivity of clinical scores to DVT. Cancer is known to cause a state of systemic hypercoagulibility through tissue factor activation, release of pro-inflammatory cytokines, platelet activation, and impaired endothelial function. In addition, cancer patients often have additional risk factors such as immobilization, central venous catheter use, or chemotherapy therapy, which further increases the likelihood of thrombosis.40

Bivariate Analysis of Factors Affecting Kagoshima Score Results

Table 6 Bivariate Analysis of Factors Associated with Kagoshima Score Prediction Errors

Variabel	Correct Prediction	Wrong Prediction	p
Age (years)	56,30 ± 15,50	37,75 ± 7,14	0,023*
BMI (kg/m²)	24,02 ± 5,88	24,33 ± 8,12	0,924*
Gender			0,289**
Women	27 (96,4%)	1 (3,6%)	
Male	16 (84,2%)	3 (15,8%)	
Immobilization			0,564**
Ya	13 (100%)	0 (0%)	
No	30 (88,2%)	4 (11,8%)	
History of Cancer			0,017**
Ya	29 (100%)	0 (0%)	
No	14 (77,8%)	4 (22,2%)	

Remarks: The prediction is correct if the Well score is obtained with a high risk of DVT and is confirmed to be positive for CTA. Prediction is wrong if the Well score is obtained with a low risk DVT but confirmed positive CTA.

*Independent t-test

**Fisher Exact Test

Bivariate analysis was also performed to evaluate factors associated with Kagoshima Score prediction errors in patients with confirmed suprainguinal DVT. Just like on the Wells Score, correct prediction is defined as a patient with a confirmed DVT based on a CTA classified as high-risk DVT by the Kagoshima Score. Meanwhile, the wrong prediction is that if Kagoshima's score is obtained as a low risk of DVT but confirmed as positive for CTA.

Just like the Wells Score, patients with a false negative Kagoshima Score have a younger average age than patients who are successfully detected as high risk. This suggests that the Kagoshima Score has better sensitivity in elderly patients. These findings are in line with the basic structure of the Kagoshima Score which includes the age of ≥60 years as one of the components of the risk assessment. Thus, young patients automatically have lower baseline scores, so they have the potential to underestimate even if they have experienced DVT.

Cancer history also showed a meaningful association with Kagoshima Score prediction errors. All patients with a history of cancer were successfully classified as high risk, while false negatives were only found in patients without a history of cancer. This is very much in line with the basic concept of the Kagoshima Score which places cancer as one of the main factors in the assessment of thrombosis risk. The malignancy is known to cause systemic activation of the coagulation system and increase the tendency to thrombus formation, so the presence of cancer significantly increases the probability of patients falling into the high-risk category.

In contrast to the Wells Score, BMI did not show a meaningful relationship with the performance of the Kagoshima Score. This is likely due to the fact that BMI is not included as a major component in the Kagoshima scoring system, so BMI variations do not have a significant effect on the risk classification results.

In addition, gender and immobilization also showed no meaningful relationship with Kagoshima Score prediction errors. Although no false negatives were found in the group of patients with immobilization, the association has not reached statistical significance. It is likely that this is influenced by the limited number of samples, so that the distribution of data between groups becomes unbalanced.

When compared to the Wells Score, the Kagoshima Score shows a relatively similar pattern, where sensitivity is better in elderly patients and patients with a history of cancer. However, the Wells Score appears to be more influenced by BMI than the Kagoshima Score. These findings suggest that the two scores have different performance characteristics, although they are equally effective in detecting patients with high thrombotic risk profiles.

Research Limitations

This study has several methodological limitations that are important to consider in the interpretation of the research results. First, this study used a retrospective design based on medical records, so the quality of the data is highly dependent on the completeness and consistency of the available clinical documentation. Some clinical variables used in the calculation of the Wells Score and Kagoshima Score have the potential to be not fully or uniformly documented, which can cause biased information in the assessment of clinical scores.

Second, this study used a case-only design, where all subjects were patients with suprainguinal DVT who had been confirmed positive based on CTA. The absence of a group of patients without DVT caused this study to not be able to evaluate diagnostic accuracy parameters as a whole, such as specificity, positive predictive value, negative predictive value, and likelihood ratio. In addition, the analysis of the ROC curve (receiver operating characteristic) and the calculation of the area under the curve (AUC) cannot be validly carried out because the ROC analysis requires the distribution of two outcome groups, namely patients with and without disease. In this study, all subjects were in the DVT-positive group, so there was no negative group needed to assess the discriminatory ability of clinical scores in distinguishing patients with and without DVT. Therefore, this study can only evaluate the detection ability (sensitivity) of both clinical scores in a population of confirmed suprainguinal DVT patients.

Third, this study was conducted in one health care center (single-center) with a relatively limited number of samples and the dominance of patients with high thrombotic risk factors such as malignancy. This condition may affect the distribution of study population characteristics and limit the generalization of results to a broader population, especially in healthcare facilities with different patient characteristics.

CONCLUSION

Overall, this study shows that the most common clinical manifestation of suprainguinal DVT was lower extremity edema, followed by superficial venous dilatation and lower extremity pain. However, these clinical findings remain nonspecific and are insufficient for establishing a diagnosis independently. In the diagnostic assessment, the Kagoshima Score and Wells Score both demonstrated high sensitivity for detecting suprainguinal DVT, with sensitivities of 91.5% and 89.4%, respectively. Although the Kagoshima Score showed slightly higher sensitivity, the difference was minimal, indicating comparable diagnostic performance between the two scoring systems. Both tools may therefore be useful for increasing clinical suspicion of suprainguinal DVT, particularly in healthcare facilities with limited access to advanced vascular imaging.

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