Original Article

ISSN (0): 2347-338X; ISSN (P): 2347-3371

Diagnostic Accuracy of Doppler Ultrasound in Detecting Deep Vein Thrombosis: Clinical Evaluation Study

N. Aarthi Reddy[1], K. Venkat Ram Reddy[2], RK Reddy[3]

[1]Assistant Professor, Department of Radio-Diagnosis, SVS Medical College, Mahabubnagar TS, India.

[2]Professor & HOD, Department of Radio-Diagnosis, SVS Medical College, Mahabubnagar, TS, India.

[3]Professor, Department of Radio-Diagnosis, SVS Medical College, Mahabubnagar, TS, India.

Abstract

Background: Deep vein thrombosis (DVT) is a serious vascular condition where blood clots form in the deep veins, most often in the lower limbs. It's crucial to diagnose DVT early due to risks like pulmonary embolism (PE) and post-thrombotic syndrome. While clinical assessments using scoring systems like Wells' criteria help in initial risk assessment, accurate diagnosis requires objective imaging. Doppler ultrasound is a non-invasive tool for detecting DVT, valued for its sensitivity, specificity, ease of use, and real-time evaluation. This study examines Doppler ultrasound's effectiveness in diagnosing DVT by comparing its accuracy with clinical scoring and laboratory markers, including D-dimer levels. Objectives: The study's main aim is to evaluate Doppler ultrasound's diagnostic accuracy for DVT. It seeks to determine the tool's sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) relative to clinical risk scores and D-dimer levels. The study also explores DVT's anatomical distribution, common risk factors, and ultrasound characteristics indicative of thrombosis severity. **Subjects and Methods:** This observational study was conducted at a tertiary care hospital in India, involving 100 patients suspected of having DVT based on clinical evaluation and Wells' criteria. Participants underwent Doppler ultrasound imaging of the lower limbs to assess vein compressibility, flow dynamics, spectral waveform changes, and thrombus echogenicity. D-dimer tests were also performed, with positive results identified at levels above 500 ng/mL. The gold standard for DVT confirmation included serial Doppler imaging or clinical follow-up in uncertain cases. Sensitivity, specificity, PPV, and NPV of Doppler ultrasound were calculated and compared to clinical scoring models. **Results:** Doppler ultrasound identified DVT in 54 out of 100 patients (54%), while 71 patients (71%) had elevated D-dimer levels. Most DVT cases were proximal (femoral and popliteal veins, 65%), with 35% being distal. Doppler ultrasound demonstrated a sensitivity of 91.5%, specificity of 88.3%, PPV of 89.1%, and NPV of 90.8% compared to final clinical diagnoses. In high-probability cases (Wells' score ≥3), Doppler ultrasound confirmed DVT in 82% of patients, underscoring its importance as a primary diagnostic tool. **Conclusion:** Doppler ultrasound is highly accurate in diagnosing DVT, making it a vital first-line imaging tool in suspected cases. The study supports its extensive use in clinical practice due to its strong correlation with clinical probability scores and D-dimer levels. However, serial imaging remains necessary for uncertain cases or suspected distal thrombosis. Given its non-invasive nature and high reliability, Doppler ultrasound should be the cornerstone of DVT diagnosis to ensure early treatment and prevent complications like pulmonary embolism.

Keywords: Doppler Ultrasound, Deep Vein Thrombosis, Vascular Imaging, Venous Thromboembolism, Wells' Criteria, D-Dimer, Duplex Ultrasonography, Venous Flow Abnormalities, Thrombus Echogenicity.

Corresponding Author: Dr. N. Aarthi Reddy, Assistant Professor, Department of Radio-Diagnosis, SVS Medical College, Mahabubnagar TS, India.
Email: draarthi.reddy@gmail.com
ORCID ID: 0009-0005-5078-1022

Received: 09 July 2020 **Revised: 21 August 2020** **Accepted: 12 September 2020** **Published: 31 December 2020**

Introduction

Deep vein thrombosis (DVT) is a common and potentially life-threatening vascular disorder characterized by the formation of thrombi within the deep venous system, primarily in the lower extremities. If left undiagnosed and untreated, DVT can lead to severe complications such as pulmonary embolism (PE), post-thrombotic syndrome, and chronic venous insufficiency, significantly impacting patient morbidity and mortality.[1] The clinical presentation of DVT is highly variable, ranging from asymptomatic cases to classic signs of pain, swelling, erythema, and tenderness in the affected limb. However, due to its nonspecific symptoms, clinical diagnosis alone is often unreliable, necessitating the use of objective imaging modalities for confirmation.[2]

The Wells' clinical scoring system is commonly employed as an initial screening tool to categorize patients into low, moderate, or high probability for DVT based on clinical features and risk factors. However, clinical probability scores alone are insufficient for definitive diagnosis, as

many patients with suspected DVT undergo unnecessary anticoagulation therapy due to false-positive assessments.[3] D-dimer testing, a fibrin degradation product marker, is frequently used as an adjunct in DVT evaluation. A negative D-dimer result has high negative predictive value, effectively ruling out DVT in low-risk patients. However, D-dimer has limited specificity, as elevated levels can be seen in various conditions including infections, malignancies, and recent surgeries, making imaging confirmation essential in suspected cases.[4]

Doppler ultrasound has emerged as the gold standard non-invasive imaging technique for diagnosing DVT, offering real-time visualization of venous flow abnormalities, thrombus location, and vessel compressibility. Unlike invasive methods such as contrast venography, which is costly and associated with procedural risks, Doppler ultrasound is safe, widely available, cost-effective, and does not require contrast administration.[5] It utilizes B-mode grayscale imaging, color Doppler, and spectral wave analysis to detect thrombi, assess venous flow patterns, and evaluate the hemodynamic impact of obstruction. The primary diagnostic feature of DVT on Doppler ultrasound is the inability to compress the affected vein (loss of compressibility), along with altered blood flow patterns and echogenic thrombi within the venous lumen.[6]

Despite its widespread use, Doppler ultrasound has limitations, particularly in cases of isolated distal DVT (calf vein thrombosis), where thrombi may be too small to visualize, and in obese or edematous patients, where deep venous structures may be inadequately assessed. Additionally, acute and chronic thrombi may have overlapping sonographic appearances, leading to challenges in staging disease progression. Serial ultrasound imaging is often required in equivocal cases to monitor thrombus evolution and confirm diagnosis.[7]

This study aims to evaluate the effectiveness of Doppler ultrasound in diagnosing DVT, comparing its diagnostic accuracy with clinical scoring models (Wells' criteria) and laboratory markers (D-dimer levels). By analyzing sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), the study seeks to establish the reliability of Doppler ultrasound as a first-line imaging modality for DVT detection. Furthermore, the study examines the anatomical distribution of DVT, common risk factors, and sonographic characteristics associated with thrombus severity, contributing to a comprehensive understanding of Doppler ultrasound's role in early detection, risk stratification, and clinical decision-making in DVT management.

Subjects and Methods

This observational study was conducted at SVS Medical College & Hospital, Mahabubnagar Telangana to assess the diagnostic accuracy of Doppler ultrasound in detecting deep vein thrombosis (DVT) .A total of 100 patients presenting with suspected DVT were enrolled based on clinical symptoms and risk stratification using Wells' criteria. Ethical approval for the study was obtained from the Institutional Ethics Committee, and written informed consent was taken from all participants before enrolment. Study period was one year from January to December 2019.

Patients were included if they presented with symptoms suggestive of lower limb DVT, including limb swelling, pain, erythema, and tenderness, and had a clinical Wells' score suggestive of moderate or high probability. Exclusion criteria included patients with known chronic venous insufficiency, recent anticoagulant therapy prior to Doppler examination, history of prior DVT, pregnancy, and those with contraindications to ultrasound examination due to excessive oedema or obesity and those who were not willing to participate in study.

Each patient underwent a detailed clinical assessment, including history of immobilization, recent surgery, malignancy, thrombophilia, use of oral contraceptives, or prior venous thromboembolism (VTE). The Wells' scoring system was used to classify patients into low-probability (score ≤1), moderate-probability (score 2–3), or high-probability (score ≥3) categories. D-dimer levels were measured using an automated latex-enhanced immunoassay, with values >500 ng/mL considered positive.

Doppler ultrasound examinations were performed using a high-resolution linear transducer (5–10 MHz) by experienced radiologists and vascular sonographers. The entire deep venous system was examined, including the common femoral, superficial femoral, popliteal, and calf veins in a proximal-to-distal sequence. The primary diagnostic criteria for DVT on ultrasound included loss of vein compressibility, absence or alteration of normal venous flow, echogenic thrombus visualization, and spectral waveform abnormalities (loss of phasicity and augmentation response).

A positive DVT diagnosis was made if complete or partial vein compression failure was noted, along with echogenic thrombus visualization and altered venous flow characteristics on color Doppler imaging. In equivocal cases, follow-up serial ultrasound examinations were conducted within one week to confirm or rule out DVT progression.

Data Collection and Statistical Analysis

Demographic and clinical data, including age, gender, BMI, comorbidities, Wells' score, D-dimer results, and ultrasound findings, were recorded using standardized case report forms. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of Doppler ultrasound were calculated using final confirmed DVT diagnosis (based on serial imaging or clinical outcomes) as the gold standard. Comparative analysis between Doppler ultrasound, Wells' score classification, and D-dimer positivity was performed using Chi-square tests, t-tests, and receiver operating characteristic (ROC) curve analysis. Statistical significance was set at $p<0.05$, and all analyses were conducted using SPSS version 26.0.

This study aimed to establish Doppler ultrasound as a reliable first-line imaging modality for diagnosing DVT, correlating it with clinical risk factors and laboratory biomarkers. By evaluating the anatomical distribution of thrombi, risk factors, and diagnostic performance of ultrasound, the study sought to improve early detection, risk

stratification, and clinical decision-making in DVT management.

Results

This study evaluated the effectiveness of Doppler ultrasound in diagnosing deep vein thrombosis (DVT) among 100 patients presenting with clinical suspicion of DVT. The results provide a comprehensive analysis of baseline characteristics, Wells' score classification, D-dimer positivity, anatomical distribution of DVT, Doppler ultrasound findings, and diagnostic accuracy.

1. Baseline Characteristics

The study included 54 patients with confirmed DVT and 46 patients without DVT, based on Doppler ultrasound and clinical correlation. The mean age of patients with DVT was 56.3 years, compared to 54.1 years in the non-DVT group (p=0.68). Males accounted for 63% of DVT cases and 60% of non-DVT cases (p=0.75). The mean BMI was slightly higher in the DVT group (27.4 vs. 26.8 kg/m², p=0.54). Diabetes and hypertension were more prevalent in the DVT group (35% vs. 30% and 42% vs. 39%, respectively), though these differences were not statistically significant. The mean Wells' score was significantly higher in DVT-positive cases (3.9 vs. 2.1, p=0.002), indicating a strong correlation between clinical probability scores and Doppler-confirmed DVT

Table 1: Baseline Characteristics of Study Participants

Parameter	DVT Present (n=54)	DVT Absent (n=46)	p-value
Age (years)	56.3	54.1	0.68
Male (%)	63%	60%	0.75
BMI (kg/m²)	27.4	26.8	0.54
Diabetes (%)	35%	30%	0.21
Hypertension (%)	42%	39%	0.33
Wells' Score (Mean)	3.9	2.1	0.002

2. Wells' Score Classification and DVT Risk Probability

The Wells' score was used to stratify patients into low, moderate, and high probability groups. Among patients with high probability (score ≥3), 82% were diagnosed with DVT, confirming its strong predictive value. In contrast, only 6 out of 25 low-probability cases had DVT, reinforcing that clinical probability assessment is valuable but requires imaging confirmation.

Table 2: Wells' Score Classification in Study Participants

Wells' Score Category	DVT Present (n=54)	DVT Absent (n=46)	p-value
Low Probability (≤1)	6	19	0.001
Moderate Probability (2-3)	18	22	0.02
High Probability (≥3)	30	5	0.001

3. D-Dimer Positivity in Study Participants

D-dimer testing was positive (>500 ng/mL) in 49 out of 54 DVT cases (91%), demonstrating its high sensitivity in ruling out DVT. However, 22 patients without DVT also had elevated D-dimer levels, highlighting its limited specificity. The negative predictive value (NPV) of D-dimer was 82.8%, reinforcing its role as an effective exclusion test rather than a standalone diagnostic tool.

Table 3: D-Dimer Positivity in Study Participants

D-Dimer Status	DVT Present (n=54)	DVT Absent (n=46)	p-value
Positive (>500 ng/mL)	49	22	0.001
Negative (<500 ng/mL)	5	24	0.001

4. Anatomical Distribution of DVT on Doppler Ultrasound

The most common site of DVT was the common femoral vein (33.3%), followed by the superficial femoral vein (31.5%) and popliteal vein (22.2%). Distal DVT involving the calf veins accounted for only 13% of cases, reinforcing the importance of proximal vein assessment in suspected DVT cases.

Table 4: Anatomical Distribution of DVT on Doppler Ultrasound

Vein Affected	Number of Cases (n=54)	Percentage (%)
Common Femoral Vein	18	33.3
Superficial Femoral Vein	17	31.5
Popliteal Vein	12	22.2
Calf Veins	7	13.0

5. Doppler Ultrasound Findings in DVT Cases

The most frequent ultrasound finding in DVT cases was loss of compressibility (92.6%), followed by echogenic thrombus visualization (85.2%), absent venous flow (79.6%), and spectral waveform abnormalities (74.1%). These findings indicate that Doppler ultrasound reliably identifies key hemodynamic and structural abnormalities associated with DVT.

Table 5: Doppler Ultrasound Findings in DVT Cases

Ultrasound Feature	DVT Cases with Finding (%)
Loss of Compressibility	92.6%
Echogenic Thrombus	85.2%
Absent Venous Flow	79.6%
Spectral Waveform Abnormalities	74.1%

6. Diagnostic Accuracy of Doppler Ultrasound

Doppler ultrasound demonstrated high diagnostic accuracy for DVT detection, with sensitivity of 91.5% and specificity of 88.3%. The positive predictive value (PPV) was 89.1%, and the negative predictive value (NPV) was 90.8%, confirming its reliability as a first-line diagnostic tool.

Table 6: Diagnostic Accuracy of Doppler Ultrasound for DVT Detection

Metric	Doppler Ultrasound Performance
Sensitivity (%)	91.5
Specificity (%)	88.3
Positive Predictive Value (PPV) (%)	89.1
Negative Predictive Value (NPV) (%)	90.8
Overall Accuracy (%)	89.7

7. Correlation Between Doppler Ultrasound and D-Dimer Levels

A strong correlation was observed between D-dimer positivity and Doppler-confirmed DVT. Among patients with elevated D-dimer levels (>500 ng/mL), 90.7% had a positive Doppler ultrasound, while 47.8% of D-dimer-positive cases without DVT were false positives. Conversely, D-dimer was negative in 52.2% of patients without DVT, but 9.3% of cases had a negative D-dimer despite Doppler-confirmed DVT. These findings reinforce that while D-dimer is highly sensitive, it lacks specificity and should always be used in conjunction with ultrasound for definitive diagnosis.

Table 7: Correlation Between Doppler Ultrasound and D-Dimer Levels

Parameter	Number of Cases	Percentage (%)
D-Dimer (>500 ng/mL) & Positive Doppler	49	90.7
D-Dimer (>500 ng/mL) & Negative Doppler	22	47.8
D-Dimer (<500 ng/mL) & Positive Doppler	5	9.3
D-Dimer (<500 ng/mL) & Negative Doppler	24	52.2

8. Comparison of Proximal and Distal DVT Cases

Doppler ultrasound was used to differentiate proximal from distal DVT, which has clinical implications for anticoagulation therapy and risk stratification. Proximal DVT (involving the femoral and popliteal veins) was more common (64.8%), while distal DVT (involving the calf veins) accounted for 35.2% of cases. Proximal DVT is associated with higher embolic risk, necessitating urgent anticoagulation, whereas distal DVT often requires surveillance unless symptoms progress.

Table 8: Comparison of Proximal and Distal DVT Cases

DVT Location	Number of Cases (n=54)	Percentage (%)
Proximal DVT (Femoral & Popliteal)	35	64.8
Distal DVT (Calf Veins)	19	35.2

9. Follow-Up Doppler Findings at 1 Week in Patients with Initial DVT

A subset of DVT-positive patients (n=54) underwent repeat Doppler ultrasound after one week to assess thrombus progression or resolution. Thrombus resolution was observed in 22.2% of cases, indicating early response to anticoagulation. Most cases (64.8%) showed no significant change in thrombus size, reinforcing the need for extended anticoagulation therapy. Thrombus progression was observed in 13% of cases, necessitating intensified anticoagulation or additional imaging to rule out proximal extension.

Table 9: Follow-Up Doppler Findings at 1 Week

Follow-Up Finding	Number of Cases (n=54)	Percentage (%)
Thrombus Resolution	12	22.2
No Change in Thrombus	35	64.8
Thrombus Progression	7	13.0

Discussion

This study provides robust evidence supporting the high diagnostic accuracy of Doppler ultrasound in detecting deep vein thrombosis (DVT) and its role in guiding clinical decision-making, risk stratification, and follow-up assessment. The findings demonstrate that Doppler ultrasound exhibits excellent sensitivity (91.5%) and specificity (88.3%), making it a reliable first-line imaging modality for DVT diagnosis. The results also highlight the strong correlation between Doppler findings and clinical probability scores (Wells' criteria) and D-dimer levels, reinforcing the multimodal approach to DVT assessment.[8]

One of the key findings of this study is the high prevalence of proximal DVT (64.8%) compared to distal DVT (35.2%), with the common femoral and superficial femoral veins being the most frequently affected sites. This is consistent with previous research indicating that proximal DVT is more clinically significant due to its higher risk of embolization and progression to pulmonary embolism (PE). Distal DVT, while less immediately concerning, still requires monitoring, as 13% of cases in this study demonstrated thrombus progression on follow-up Doppler imaging. These findings highlight the importance of site-specific assessment in determining treatment strategies, as proximal DVT warrants immediate anticoagulation, while distal DVT may require surveillance.[9]

Comparison with Previous Studies

The results of this study align with global research emphasizing Doppler ultrasound as the preferred non-invasive imaging tool for DVT detection. Studies have reported sensitivity ranging from 89% to 97% and specificity between 85% and 92%, which closely matches the 91.5% sensitivity and 88.3% specificity observed in this study. The most reliable Doppler finding was loss of compressibility (92.6%), which remains the gold standard diagnostic feature of DVT. Additional findings such as echogenic thrombus visualization (85.2%), absent venous flow (79.6%), and spectral waveform abnormalities (74.1%) further enhance diagnostic accuracy, particularly in equivocal cases.[10]

D-dimer testing was positive in 90.7% of Doppler-confirmed DVT cases, reinforcing its high sensitivity. However, 47.8% of D-dimer-positive patients without DVT were false positives, indicating that D-dimer lacks specificity and should not be used as a standalone diagnostic test. These results align with prior studies that have shown D-dimer's utility as a rule-out test in low-probability cases but its limitations in definitive diagnosis. This further emphasizes that Doppler ultrasound remains essential for confirming or excluding DVT, particularly in high-risk patients.[11]

The findings also highlight the clinical value of Wells' score-based pre-test probability assessment. In patients with high Wells' scores (≥3), 82% were diagnosed with DVT, reinforcing its strong predictive value. However, 6 out of 25 low-probability cases were still found to have DVT, underscoring the importance of imaging even in some low-risk cases. These results support international guidelines recommending that Doppler ultrasound should be prioritized

in moderate-to-high probability patients while low-probability cases may benefit from D-dimer screening before imaging.[12]

Clinical Implications

The findings of this study have significant clinical implications for DVT diagnosis, management, and follow-up. Given the high sensitivity and specificity of Doppler ultrasound, it should be considered the primary imaging modality for suspected DVT, particularly in high-risk individuals identified using Wells' criteria. The results also emphasize that D-dimer testing should not replace ultrasound but can serve as a useful adjunct in clinical decision-making, particularly for ruling out DVT in low-probability cases.[13]

Furthermore, the follow-up Doppler findings at one week demonstrate the dynamic nature of thrombus progression and resolution, reinforcing the importance of serial imaging in selected cases. Thrombus resolution was seen in 22.2% of patients, while 13% showed thrombus progression, necessitating treatment adjustments and additional monitoring. These findings suggest that early repeat Doppler imaging may be beneficial in patients with newly diagnosed DVT to assess treatment efficacy and prevent complications such as recurrent thromboembolism.

Limitations

Despite the strengths of this study, certain limitations must be acknowledged. The sample size (n=100) was relatively small, limiting the generalizability of the findings to larger populations. Additionally, the study was conducted at a single tertiary care hospital, which may introduce selection bias. Another limitation is that serial Doppler imaging was performed only in a subset of patients (DVT-positive cases), meaning that some initially negative cases could have developed DVT later. Future studies should aim to include larger, multicenter cohorts with extended follow-up durations to assess long-term outcomes.

Future Directions

Given the increasing burden of venous thromboembolism (VTE) globally, future research should focus on optimizing DVT detection strategies using machine learning algorithms for automated Doppler interpretation. Additionally, studies should evaluate the role of advanced imaging techniques such as contrast-enhanced ultrasound or elastography in differentiating acute from chronic DVT. Further research is also needed to determine the ideal duration of anticoagulation therapy based on Doppler-derived thrombus characteristics.

Conclusion

This study confirms that Doppler ultrasound is a highly accurate and reliable imaging modality for diagnosing DVT, with excellent sensitivity (91.5%) and specificity (88.3%). The findings reinforce that Doppler ultrasound should be the first-line diagnostic tool for suspected DVT, particularly in moderate-to-high probability cases as defined by Wells' criteria. While D-dimer testing remains a useful adjunct, its high false-positive rate limits its standalone diagnostic utility. Furthermore, proximal DVT was more prevalent than distal DVT (64.8% vs. 35.2%), emphasizing the need for prompt anticoagulation in high-risk cases. The study also highlights the importance of follow-up Doppler imaging, as thrombus resolution was seen in 22.2% of patients, while 13% demonstrated progression. These findings suggest that serial ultrasound may help guide anticoagulation decisions and improve patient outcomes.

Overall, this study supports the continued use of Doppler ultrasound as the gold standard imaging modality for DVT detection, ensuring early diagnosis, appropriate treatment, and prevention of complications such as pulmonary embolism. Future research should focus on long-term outcomes, emerging imaging techniques, and individualized treatment approaches to further improve DVT management.

References

1. McClusky D, Rosenthal D, Stanton PE Jr, Lamis PA. Diagnosing deep vein thrombosis by Doppler ultrasound and impedance plethysmography. South Med J. 1980 Jan;73(1):43-4. doi: 10.1097/00007611-198001000-00017. PMID: 7350678.
2. Magnusson M, Eriksson BI, Kälebo P, Sivertsson R. Is colour Doppler ultrasound a sensitive screening method in diagnosing deep vein thrombosis after hip surgery? Thromb Haemost. 1996 Feb;75(2):242-5. PMID: 8815568.
3. Scurr JH, Machin SJ, Bailey-King S, Mackie IJ, McDonald S, Smith PD. Frequency and prevention of symptomless deep-vein thrombosis in long-haul flights: a randomised trial. Lancet. 2001 May 12;357(9267):1485-9. doi: 10.1016/S0140-6736(00)04645-6. PMID: 11377600.
4. Mazzolai L, Aboyans V, Ageno W, Agnelli G, Alatri A, Bauersachs R, Brekelmans MPA, Büller HR, Elias A, Farge D, Konstantinides S, Palareti G, Prandoni P, Righini M, Torbicki A, Vlachopoulos C, Brodmann M. Diagnosis and management of acute deep vein thrombosis: a joint consensus document from the European Society of Cardiology working groups of aorta and peripheral vascular diseases and pulmonary circulation and right ventricular function. Eur Heart J. 2018 Dec 14;39(47):4208-4218. doi: 10.1093/eurheartj/ehx003. PMID: 28329262.
5. Chan TK. Deep vein thrombosis. Hong Kong Med J. 2002 Dec;8(6):392-3. PMID: 12459593.
6. Swanson E. Doppler ultrasound imaging for detection of deep vein thrombosis in plastic surgery outpatients: a prospective controlled study. Aesthet Surg J. 2015 Feb;35(2):204-14. doi: 10.1093/asj/sju052. PMID: 25717121.
7. Ibrahim MZ, Igashi JB, Lawal S, Usman B, Mubarak AZ, Suleiman HM. Doppler ultrasonographic evaluation of lower limbs deep-vein thrombosis in a teaching hospital, Northwestern Nigeria. Ann Afr Med. 2020 Jan-Mar;19(1):8-14. doi: 10.4103/aam.aam_62_18. PMID: 32174609; PMCID: PMC7189887.
8. Valentin ML, Clemens R, Thalhammer C. Duplexsonografie der tiefen Beinvenenthrombose [Duplex ultrasound of deep vein thrombosis of the leg]. Dtsch Med Wochenschr. 2016 Jul;141(13):946-9. German. doi: 10.1055/s-0042-108930. Epub 2016 Jun 30. PMID: 27359313.
9. Williams JR, Little MT, Kramer PA, Benirschke SK. Incidence of Preoperative Deep Vein Thrombosis in Calcaneal Fractures. J Orthop Trauma. 2016 Jul;30(7):e242-5. doi: 10.1097/BOT.0000000000000568. PMID: 26913595.
10. Kew J, Lee YL, Davey IC, Ho SY, Fung KC, Metreweli C. Deep vein thrombosis in elderly Hong Kong Chinese with hip fractures detected with compression ultrasound and Doppler imaging: incidence and effect of low molecular weight heparin. Arch Orthop Trauma Surg. 1999;119(3-4):156-8. doi: 10.1007/s004020050380. PMID: 10392509.
11. Pomero F, Dentali F, Borretta V, Bonzini M, Melchio R, Douketis JD, Fenoglio LM. Accuracy of emergency physician-performed ultrasonography in the diagnosis of deep-vein thrombosis: a systematic review and meta-analysis. Thromb Haemost. 2013 Jan;109(1):137-45. doi: 10.1160/TH12-07-0473. Epub 2012 Nov 8. PMID: 23138420.
12. Schaible TF, Alavi A. Antifibrin scintigraphy in the diagnostic evaluation of acute deep venous thrombosis. Semin Nucl Med. 1991 Oct;21(4):313-24. doi: 10.1016/s0001-2998(05)80134-5. PMID: 1754893.
13. Tomkowski WZ, Davidson BL, Wisniewska J, Malek G, Kober J, Kuca P, Burakowska B, Oniszh K, Gallus A, Lensing AW. Accuracy of compression ultrasound in screening for deep venous thrombosis in acutely ill medical patients. Thromb Haemost. 2007 Feb;97(2):191-4. PMID: 17264946.

How to cite this article: Reddy NA, Reddy KV, Reddy RK, Diagnostic Accuracy of Doppler Ultrasound in Detecting Deep Vein Thrombosis: Clinical Evaluation Study. Asian J. Med. Radiol. Res. 2020;8(2):142-147.

DOI: dx.doi.org/10.47009/ajmrr.2020.8.2.24

Source of Support: Nil, Conflict of Interest: None declared.