International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2019): 7.583

Colour Doppler Ultrasonography in the Evaluation of Deep Venous Thrombosis of Lower Limbs

Dr. Rabiya Baseri Nelofar[1], Dr. G. V. Parvatheswara Rao[2], Dr. B. Jyothirmayi[3]

[1]Assistant Professor of Radio-diagnosis at ASRAM Medical College *(Corresponding Author)*

[2]Professor and Head of Department of Radio-diagnosis at Guntur Medical College

[3]Consultant Radiologist

Abstract: ***Deep venous thrombosis of lower limbs is one of the most common cause of pulmonary embolism, which in turn is responsible for the majority of deaths. The main objective of this study is to analyze the spectrum of findings on colour Doppler ultrasound in patients with clinical suspicion of DVT and also to evaluate the distribution of thrombi in the lower extremity.***

Keywords: Venous thrombosis; Ultrasonography; Lower extremities

1. Introduction

DVT is a common clinical problem that set hurdles to many medical and surgical disorders. Development of a thrombus in a vein may be reflected as functionally an exaggeration of the normal process of hemostasis.

It usually presents as pain and swelling of the affected limbs and may also cause structural damage to the valves of deep veins, which results in post-phlebitic syndrome[1]. It occurs along a continuum with propagation, extension and progression. Even in patients with deep vein thrombosis and symptoms in the lower extremities, fewer than the third present with the classic syndrome of calf discomfort, edema, venous distension, and pain on forced dorsiflexion of the foot (Homans sign).

High risk of developing DVT is seen among patients after major trauma, surgery, extended immobilization ex: in acute myocardial infarction, CCF, stroke and post-operative convalescence. Other risk factors include neoplasm, pregnancy, oral contraceptive pills and hypercoagulable states.

2. Material and Methods

Our study is carried out on 40 patients with clinical suspicion of venous thrombosis.

2.1 Inclusion Criteria

Clinically suspected cases of Deep venous thrombosis (DVT) and patients who are at increased risk of DVT.

2.2 Exclusion Criteria

a) Pediatric cases and neoplastic conditions.
b) In all patients, the following protocol was followed:
Detailed clinical history was elicited concerning onset, duration and progress of the symptoms and analysis of risk factors.

2.3 Method

The patient was examined in supine position with legs abducted and externally rotated with slight flexion of the knee for evaluation of femoral venous segment. The patient was given prone position in the assessment of the popliteal vein. Veins in calf were evaluated in supine position with the knee flexed slightly and rotated internally for the ATV and externally rotated for the PTV and peroneal veins.

Linear array transducer (7.5MHz) was used for femoral, popliteal and tibial venous segments and calf veins while 3.5 MHz convex transducer was used for evaluation of iliac veins and inferior vena cava. The Doppler report described the presence or absence of deep vein thrombosis, location, extent, nature (acute or chronic) and complications, if any.

2.3.1 Doppler characteristics of normal veins

Five essential features: It is spontaneous, phasic, ceases with the Valsalva manoeuvre, is augmented by distal compression and is unidirectional.[2]

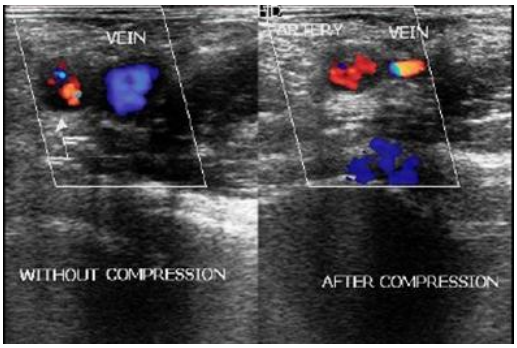

Figure 1: At each level, the first step is to search for vein, perform compression study at every few centimetres and evaluate the spontaneous flow signals by colour Doppler.

(walls of veins are thin, and the pressure of blood within the lumen holds it open. Thus, the lumen of the vein can be obliterated with a small amount of extrinsic pressure.)

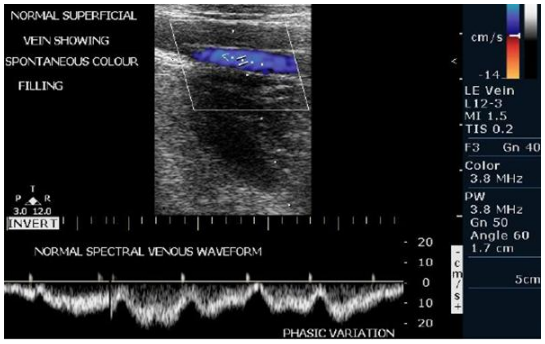

Figure 2: Showing normal spontaneous colour filling and phasic variation

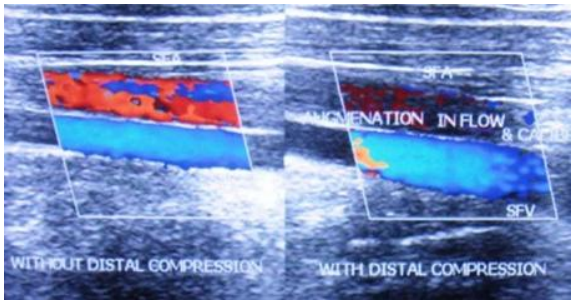

Figure 3: After this is accomplished, flow is augmented by compressing the vein below andabove the probe.

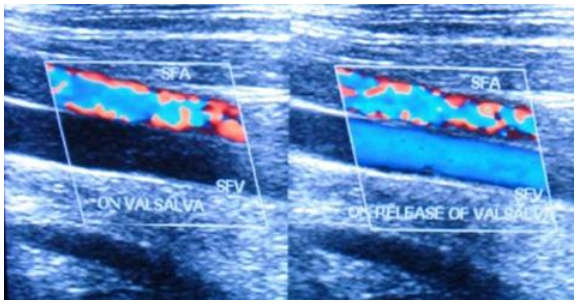

Figure 4: Valsalva manoeuvre is used to check for valvular incompetence when the risk for pulmonary embolism is thought to below

2.3.2 Color Doppler findings in venous thrombosis

The characteristic differentiation between acute and chronic thrombus is important because acute DVT has a more significant potential to embolize. Acute clot is not well attached to vein walls and is more likely to progress proximally. Characterization of the clot as acute or chronic also carries critical therapeutic implications: Acute thrombosis characteristics: Low echogenicity intraluminal material producing a flow void, venous distension, loss of compressibility, free-floating thrombus, Doppler signal abnormalities and collateralization. Chronic thrombosis characteristics: Increased echogenicity, incomplete compression.

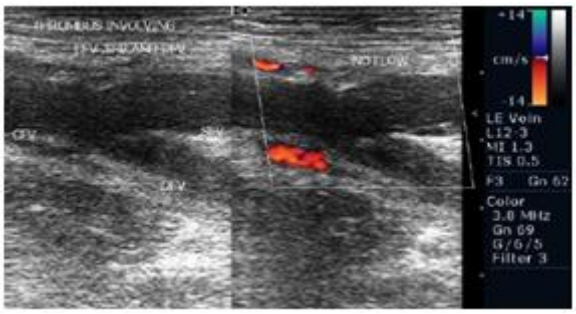

Figure 5: Longitudinal image showing thrombosis in common femoral, superficial femoral and profunda femoris veins

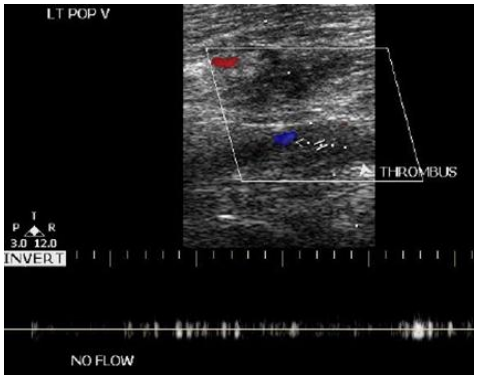

Figure 6: Longitudinal image showing echogenic materials within the common femoral vein suggestive of chronic thrombosis

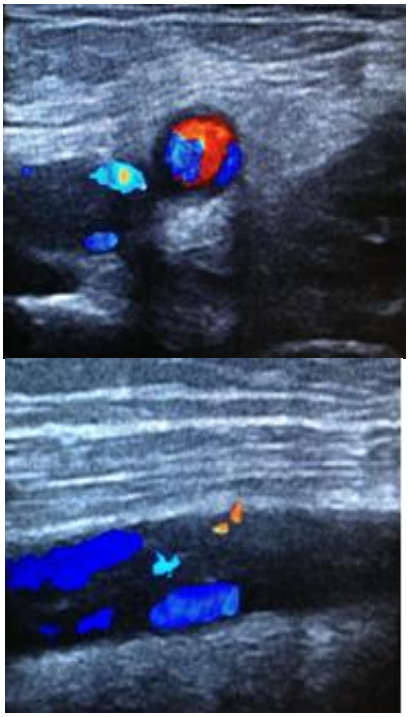

Figure 7 and 8: Axial and longitudinal image showing chronic thrombosis of common femoral vein with partial recanalization

3. Results and Discussion

Our study was performed to assess the role of colour Doppler USG in the diagnosis of DVT of the lower extremity. It included detection and assessment of the spectrum of findings of DVT by using colour Doppler

ultrasonography. We studied the colour flow findings in patients who presented with pain, edema or both of the lower extremities, pulmonary embolism and prior history of DVT. Our technique involves a complete survey of all major deep veins and superficial veins of the lower limb.

The introduction of the Doppler ultrasound technique has enduringly altered the diagnosis and treatment of DVT. The justification is quite simple: thrombotic obstruction of the underlying vein distorts the venous flow pattern, and these perturbations are readily detected by Doppler instrumentation.[3]

This technique is non-invasive, repeatable, can be performed rapidly in a clinic, a patient's bedside or even at home, and the results are available immediately. It can be used in pregnant women, permits multiple views in various positions of the leg[4], and the study is safe, painless and inexpensive[3].

Table 1: Clinical conditions in the study population for Doppler ultrasound examination for suspected DVT.

Clinical conditions	Cases with suspected DVT (n = 40)		Cases showed evidence of DVT (n = 31)	
	No	Percentage	No	Percentage
Prolonged hospitalization	12	30	9	29.03
Post-operative	3	7.5	3	9.67
Trauma	3	7.5	3	9.67
OC pill users	2	5	2	6.45
Dialysis	2	5	2	6.45
Others (Snake bite)	1	2.5	1	3.22
No known predisposing condition	17	42.5	12	38.70

Table 2: Distribution of cases by signs and symptoms

Symptoms	Cases with suspected DVT (n = 40)		Cases showed evidence of DVT (n = 31)	
	No	Percentage	No	Percentage
Pain	8	20	6	19.35
Edema	16	40	14	45.16
Pain and Edema	10	25	8	25.80
Pulmonary embolism	3	7.5	2	6.45
Asymptomatic	3	7.5	1	3.22

Table 3: Anatomic distribution of thrombi in the study population with evidence of DVT on Doppler ultrasonography

	CIV	EIV	CFV	SFV	POPV	ATV	PTV	PERV	SVS
No of cases showing involvement	3	8	18	26	23	20	14	12	4
Percentage of cases showing involvement	9.67	25.80	58.06	83.87	74.19	64.51	45.16	38.70	12.90

In our study, the range of age of patients with suspected DVT was 21-80 years, with a mean age of cases suspected to have DVT being 48.7 years and mean age being 46.25 years.

Of total 40 cases, 31 showed the presence of thrombus and 9 were negative for thrombus. Males predominated our study (70%), and also evidence of DVT was more in them (74.1%). Similar findings were seen in the study by the Hill SL et al[5](1995), which concluded that a higher incidence of DVT was seen in males.

Prolonged hospitalization was the most common prompting factor. However, in 25% of patients with DVT, no predisposing factor was found.

Edema was a predominant symptom (45.16%). This correlates with the study by Glover J et al. and Eze et al., who found 25 patients with unilateral leg swelling to have DVT in their research. In their study, 40% were found to have DVT by duplex scanning, whereas DVT was evident in only 5 % of patients in the absence of leg swelling. This is explained by the venous physiology that when major venous channels are occluded, the resultant increase in venous pressure and volume manifests itself in edema.

In the present study, only one case with bilateral pain and oedema showed evidence of thrombosis in a single limb, 29 cases with unilateral symptoms showed involvement of the same symptomatic limb. In comparison, 1 case with bilateral involvement had bilateral symptoms. This correlates with the data published by Sheiman RG et al.(1995) who indicated a low incidence of thrombus in contralateral extremity. However, in the study conducted by Colucciello SA (2001), DVT never occurred in patients with bilateral symptoms.

Unilateral limb involvement was seen in 30 cases (96.77%) and bilateral involvement in 1 case (3.23%). The data published by Sheiman RG et al. and Strothman G et al. (1995) indicates a low incidence of thrombus in contralateral extremity. This supports the unnecessity of bilateral examination in patients with unilateral extremity symptoms. However, the examination of both the lower extremities is advisable in patients with signs or symptoms of pulmonary embolism, even though one extremity is symptomatic.

Colour Doppler USG was advised to rule out DVT of lower limbs as the source of pulmonary embolism in 3 cases. This is based on the concept that the majority of pulmonary embolism originate in lower extremity veins. Amongst the 3 patients with suspected pulmonary embolism, colour Doppler USG revealed DVT in only 2 cases who had left side calf tenderness on clinical examination.

The predominant involvement of DVT was seen in left lower limb 77.41% (23 cases) and that in the right lower limb was 25.80%(8 cases). This correlated with the study conducted by Stamatakis JD et al. (1978) who found major thrombi occurring more frequently in the left lower limb.

Acute thrombosis was seenin 18 (58.06%) and chronic in 11 (41.94 %). In the study, the positivity rate for acute DVT is 45%. 21 cases (67.74%) showed evidence of complete thrombosis, while 10 cases (32.26%) demonstrated incomplete thrombosis. This finding roughly correlated

with the study by Grosser S et al. (1990). This is higher than that in the study-by Hill SL et al. (1997) who determined the positivity rate of 17.4% for acute DVT in symptomatic patients.

Colour Doppler USG helps in exact localization of the thrombus. The distribution of thrombi in our study is 9.67% in common iliac vein, 25.80 % in external iliac vein, 58.06 % in the CFV, 83.87% in SFV, 74.19 % in the popliteal vein, 64.51% in posterior tibial vein, 45.16% in anterior tibial vein, 38.70% in peroneal vein and 12.9% in the superficial veins. All the 8 cases in our study with external iliac vein thrombosis out of which 3 were showing both proximal and distal extension, i.e. into the common iliac vein and common femoral vein. This finding correlated with the study by Appleman PT et al. (1987).

Amongst 31 positive cases, thrombus was confined to the femoropopliteal system in 26 patients (83.57%) suggesting the distribution of thrombus is more common in femoropopliteal (proximal) than in calf veins (distal) which amount only 64.5%. Salzman EW et al. (1976), Hume M et al.(1976), Yao ST et al.(1974) and Cranley J et al.(1976) had stated that clots propagating into or beyond the popliteal vein assume greater clinical significance as they increase the possibility of fatal pulmonary emboli. It is found that the age of patients with contiguous thrombosis or bilateral thrombosis was more significant than the age of patients with isolated thrombosis.

In the present study, 6.45% were isolated thrombi confined to one segment, 93.55% were multiple contiguous thrombi. There is not a single case showing multiple non- contiguous involvement. The pattern of involvement which constituted the major group in our study is one with numerous contiguous involvement of venous segments in single extremity. This finding correlated with the study by Hill SL et al.

Isolated iliac vein thrombosis did not occur in this series of patients. Rose SC et al. (1990) in their study, however, identified three cases of iliac vein DVT which had non-contiguous DVT of the femoropopliteal segment.

The criterion included in the diagnosis of acute thrombosis was increased in diameter of vein, which was discovered in all 18 cases of acute thrombosis, similarly correlated with the study by van Gemmeren D et al. (1991) who had found a significant correlation between the age of thrombosis and the venous diameter ($P<0.001$).In 13 cases with chronic thrombosis 11 had normal dimension while 2 had a diameter less than the adjacent artery.

Veins compressibility was lost in all 31 cases (acute and chronic) with DVT. In 10 cases with incomplete thrombosis, involved veins were not completely compressible. In one case with suspected DVT and prior history of DVT, the femoral venous segment in the region of adductor canal was not compressible. The diagnosis of DVT in this segment was excluded from demonstrating normal colour flow signal. This was found in the study by Wright DJ et al.(1990) who had detailed the difficulty in ascertaining the compressibility of the vein due to its thick muscular structure as in adductor canal.

In the present study, only one case with acute DVT showed the free-floating proximal end of the thrombus. Norris CS et al.(1985) found 5 cases out of 78 (6%) with free-floating thrombi on venography. The eccentric flow was demonstrated in 10 patients with partial thrombosis correlated with the study by Rose SC et al. (1990).

In 3 patients with acute DVT, collaterals were demonstrated while in 5 patients with chronic DVT, collaterals and increased flow through saphenous veins were demonstrated.

This correlated with the study by Persson AV et al.(1989), who found an increase in the size and flow in collateral veins, in the majority of patients with acute deep venous thrombosis.

9 cases (22.5%) in the study population demonstrated clinical conditions mimicking DVT, 1 showed the presence of Baker's cyst of, 1 had ruptured Baker's cyst at clinical presentation with pain and marked swelling of the calf, clinically indistinguishable from DVT. 2 cases showed evidence of cellulitis with subcutaneous swelling. Inflamed bursa was found in 2 cases as the cause of pain in patients with suspected DVT of which one was associated with fascitis. Intramuscular haematoma was found in the left rectus femoris muscle in 2 patients who also had Doppler evidence of partially recanalized thrombus indistal SFV.

4. Conclusion

It has been established that colour Doppler USG, a non-invasive, accurate, easily repeatable, widely available and relatively sensitive in the diagnosis of lower extremity deep vein thrombosis and also helps in providing valuable information of therapeutic significance and risk of pulmonary embolism.

References

[1] Fraser JD, Anderson DR. Deep venous thrombosis. Recent advances and optimal investigation with US. Radiol 1999; 211:9-24.
[2] Zwiebel WJ. Duplex sonography of the venous system. Semin ultrasound CT MR1988;9:269-326.
[3] Sumner DS, Lambeth A. Reliability of Doppler ultrasound in the diagnosis of acute venous thrombosis both above and below the knee. Am J Surg1979; 138:205-209.
[4] Langsfeld M, Hershey FB. Duplex B-mode imaging for the diagnosis of deep venous thrombosis. Arch Surg 1987; 122:587-591.
[5] Hill SL, Holtzman GI. Selective use of the duplex scan in diagnosis of deep venous thrombosis. 1995; 170:201-205.