



## ROLE OF COLOUR DOPPLER IN EVALUATION OF LOWER LIMB DEEP VEIN THROMBOSIS

**Dr. Prateek Singh\***

Assistant Professor, Department of Radiology, NCMCH, Panipat-132107, Haryana, India. \*Corresponding Author

**Dr. Taranpreet Singh Kochhar**

Senior Resident, Department of Radiology, NCMCH, Panipat-132107, Haryana, India.

### ABSTRACT

**Background:** Deep venous thrombosis is common cause of pulmonary thromboembolism thus is indirectly responsible for significant mortality. Most venous thrombi are clinically silent so their early diagnosis is must to prevent avoidable deaths.

**Objective:** To study the risk factors associated with DVT and evaluate the role of color Doppler ultrasound to study characterization, classification, distribution of lower limb DVT.

**Material and Methods:** Prospective descriptive analytical study was carried out on 46 patients of DVT diagnosed on Venous Doppler in the Department of Radiology, from July 2019 to April 2020. Analysis of cases of DVT was done in terms of age and sex wise distribution, symptoms and signs, predisposing conditions, anatomic distribution, stage of involvement of thrombus and pattern of involvement of veins.

**Result:** Unilateral lower limb involvement was seen in 44 (95.65%) cases with predominant involvement of left limb in 37 cases. Mean age was 43.12 years and highest incidence noted in the fifth decade. Male predominance was found that constituted 63 % of the cases. Edema (91.3%) was most common presenting symptom. It was found that prolonged hospitalization was the most common predisposing factor. Predominant distribution of thrombus in our study was found to be in the above knee region.

**Conclusion:** Duplex Doppler acts as a first line investigation and can help in early detection of DVT in clinically suspected cases and favours prompt treatment of the patients.

**KEYWORDS :** Colour Doppler, Deep Venous Thrombosis, Lower Limb

### INTRODUCTION

Deep venous thrombosis (DVT) is relatively underdiagnosed health problem but common aetiology of pulmonary thromboembolism (PE) and thus is indirect cause of significant mortality. PE is the third most common cause of hospital related death and the most common preventable cause of hospital related death. The majority of patients die because of a failure in diagnosis rather than inadequate therapy. In fact, the mortality rate for PE without treatment is approximately 30%. Early diagnosis of DVT is mandatory to prevent avoidable deaths from PE<sup>1</sup>.

The incidence of DVT in the general population has been estimated to be 80-100/1,00,000 annually in the western societies and 4-75/1,00,000 in South-Asia. In India, overall incidence of DVT in the general population is largely unknown and literature survey shows scanty works in this field<sup>2-4</sup>.

Exaggeration of the normal process of haemostasis may be considered as a functional cause for development of a venous thrombus. DVT occurs along a continuum with propagation, extension and progression<sup>5</sup>. It may in turn cause structural damage to the deep venous valves resulting into post-phlebitic syndrome<sup>6</sup>. Major surgery, trauma, prolonged immobilization, neoplasms, pregnancy, oral contraceptive pills and hypercoagulable states are a commonly known risk factor of DVT.

DVT commonly presents with pain and swelling of affected lower limbs. Probably because DVT do not totally obstruct the vein in early stages and also due to the presence of collateral circulation, most venous thrombi are clinically silent when they are first detectable by objective methods. Fewer than the third patients among those having symptoms in the lower extremities present with the classic syndrome of edema, calf discomfort, venous distension and pain on forced dorsiflexion of the foot (*Homan's sign*).

Various invasive contrast-based techniques like venography, phlethysmography, CT venography are used for evaluation of DVT but diagnosis and treatment of DVT has irrevocably been altered after the introduction of Doppler ultrasound technique.

The principle is quite simple: thrombotic obstruction of the underlying vein distorts the venous flow pattern and these perturbations are readily detected by the Doppler instrument. Advantages are can be used in pregnant women, permits multiple views in various positions of leg and it is safe, non-invasive, painless, inexpensive and easily available. The color Doppler findings of DVT are helpful for planning medical management and for post treatment surveillance<sup>7</sup>.

Our study objectives were to study the risk factors associated with DVT and evaluate the role of color Doppler ultrasound to study characterization, classification, distribution of lower limb DVT.

### MATERIALS AND METHODS

A prospective descriptive analytical study was carried out on 46 patients of DVT diagnosed on Venous Doppler in the Department of Radiology, NCMCH, Panipat from July 2019 to April 2020. The Ultrasound Doppler examinations were performed on LOGIQ P5 equipped with colour Doppler.

**Inclusion criteria** was DVT diagnosed on B-mode and color Doppler study in clinically suspected cases of DVT.

**Exclusion criteria:** Patients who were pregnant, suffering from lower limb trauma or degloving injuries or burns or neoplasm were excluded from the study.

The veins were evaluated for:

- Absent or reduced compressibility of the vein.
- Static valve leaflets.
- Thrombus in the vein, static echoes in complete color fill in full expansion of vein.
- Absent flow on spectral color Doppler.
- Impaired or absent augmentation of flow.
- Loss of spontaneous and respiratory variation.
- Increased flow in controlled canal.

The following criteria were followed in this study for diagnosis of DVT<sup>8</sup>

- Visualization of thrombus.

- Vein compressibility.
- Vein size.
- Respiratory changes

Analysis of cases of DVT was done in terms of age and sex wise distribution, symptoms and signs, predisposing conditions, anatomic distribution, stage of involvement of thrombus (acute, sub-acute and chronic) and pattern of involvement of veins.

**STATISTICAL ANALYSIS**

Statistical analysis was achieved using SPSS v22 for Windows (SPSS Inc, Chicago, IL, USA) after collecting patient data in a master chart.

**RESULTS**

A total of 46 patients were identified to have DVT. Bilateral lower limb DVT was observed in 2 cases (4.34%), unilateral lower limb involvement was seen in 44 (95.65%) cases, thus showing predominant unilateral lower limb involvement. Total number of extremities involved were 48. Left lower limb involvement was seen in 37 (77.0%) cases, right lower limb involvement was seen in 11 (22.91%) cases. The left lower limb predominance was noted in our study.

The age of patients ranged from 16 to 82 years with a mean age of 43.12 years. The incidence was highest in the fifth decade [Figure 1].

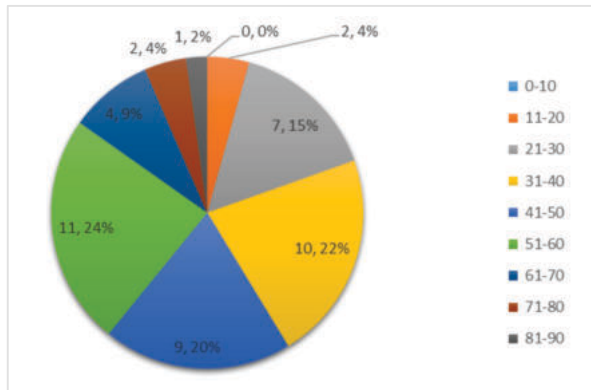


Figure 1: Age group wise distribution (in Years)

Out of the 46 patients showing evidence for DVT, male predominance was found that constituted 63 % of the cases [Figure 2].

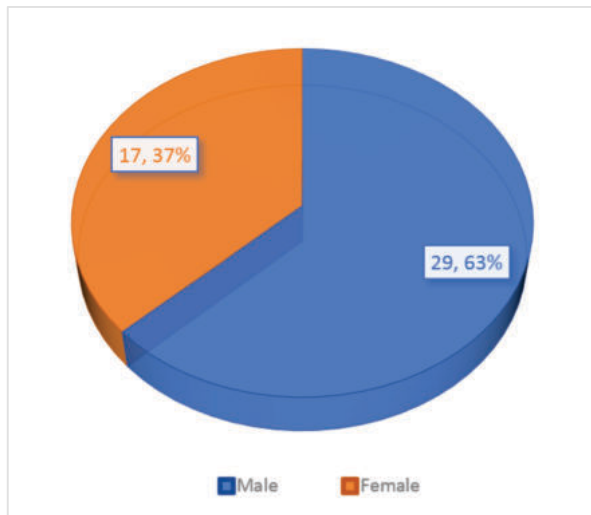


Figure 2: Gender distribution

Edema (91.3%) was most common presenting symptom

[Figure 3]. It was found that prolonged hospitalization was the most common predisposing factor, followed by postoperative cases. However no predisposing condition was found in the 28.26% of the patients [Figure 4].

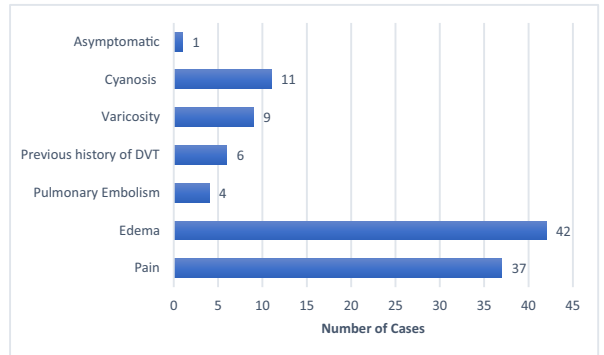


Figure 3: Distribution of cases by signs and symptoms

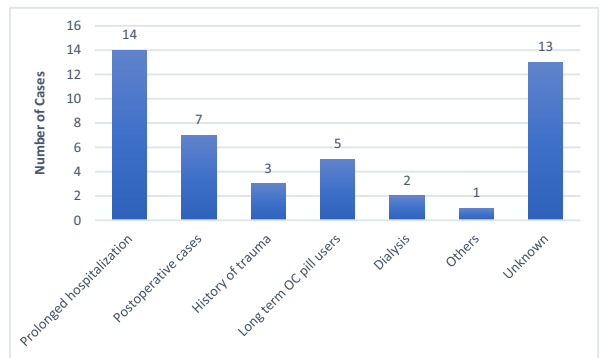


Figure 4: Distribution of cases by predisposing conditions

Predominant distribution of thrombus in our study was found to be in the above knee region with approximately (75%) of the patients having thrombus in the superficial femoral vein [Table 1].

The predominant stage of DVT was that of subacute thrombus (52.17%) followed by acute stage (32.61%) and chronic stage (15.22%) [Table 2].

Complete thrombosis was observed in 31 patients (67.39%), while partial thrombosis was observed in 15 patients (32.60%). The pattern of involvement was predominantly of multiple contiguous type which constituted around 89.13% [Table 3].

Table 1: Anatomic distribution of thrombi

Veins involved	CFV	SFV	PV	PTV	ATV	PER	CIV	EIV	SVS
No. of limbs	31	36	29	28	19	15	7	12	5
Percentage	64.5	75.0	60.4	58.3	39.5	31.2	14.5	25.0	10.4
	8	0	2	3	8	5	8	0	2

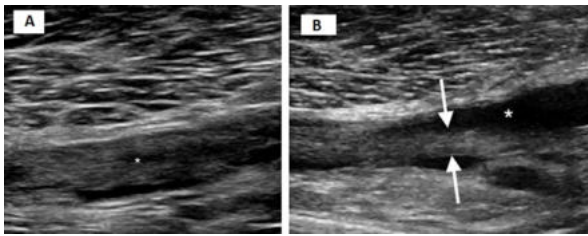
CFV: Common femoral vein, SFV: Superficial femoral vein, PV: Popliteal vein, PTV: Posterior tibial vein, ATV: Anterior tibial vein, PER: Peroneal vein, CIV: Common iliac vein, EIV: External Iliac Vein, SVS: Superficial venous system

Table 2: Stage of involvement of the thrombus

Stage of involvement	No. of cases	Percentage
• Acute	15	32.61
• Subacute	24	52.17
• Chronic	7	15.22

Table 3: Pattern of involvement of the veins

Pattern of involvement	No. of cases	Percentage
• Multiple contiguous	41	89.13
• Isolated	4	8.69
• Multiple non-contiguous	1	2.17



**A: Heterogeneous acute thrombus.** **B: Chronic post-thrombotic change.**

**Figure 3. Long-axis sonogram of the left popliteal vein**

## DISCUSSION

Out of the 48 limbs showing evidence for DVT amongst the 46 patients (2 cases of bilateral limb involvement), the commonest involvement was found to be of the left lower limb (77.0%). This correlated well with the venographic study conducted by *Stamatakis et al.*<sup>9</sup> who found out that major thrombi occurred more frequently in left lower limb.

In our study the mean age was 43.12 years. In their study series *Hill et al.* found mean age of presentation for men to be 60.3 years and that for females 65.5 years. Males (63%) dominated our study and it correlates well with the study conducted by *Hill et al.* which had higher incidence of DVT among males<sup>6,10</sup>.

The majority of the patients (42/46) in our study had edema as the most common presenting symptom which constituted 91.3% of all the patients, followed by pain (80.43%) while 1 patient was asymptomatic. This correlates with the study conducted by *Glover and Bendick*<sup>11</sup> and *Eze et al.*<sup>12</sup> in which 25 patients with unilateral leg swelling were found to have DVT. In their study, only 5% of patients were found to have DVT in absence of leg swelling. This is well explained by the physiologic process that when major venous channels get occluded, there is resultant increase in venous pressure and volume which manifests into edema. This also correlates with the study conducted by *Langsfeld et al.*<sup>7</sup> who found edema as the most common sign in patients diagnosed with DVT. The four patients (8.46%) that presented with pulmonary embolism were simultaneously diagnosed to have DVT.

The most common predisposing condition was prolonged hospitalization in 14 cases (30.43%) however, 13 patients (28.26%) had no known predisposing condition. *Heit et al.*<sup>13</sup> had concluded in their study that hospital or nursing home confinement, surgery, trauma, malignant neoplasm, chemotherapy are independent and important risk factors for DVT.

In our study, thrombosis was localized to the superficial femoral vein in 36 limbs (75%), CFV in 31 limbs (64.58%), popliteal vein in 29 limbs (60.42%), posterior tibial vein in 28 limbs (58.33%), anterior tibial vein in 19 limbs (39.58%), peroneal vein in 15 limbs (31.25%), external iliac vein in 12 limbs (25%), common iliac vein in 7 limbs (14.58%) and the superficial venous system was involved simultaneously in 5 limbs (10.42%). All the cases of superficial venous systems involved showed direct contiguous extension either through the femoral into GSV or through the popliteal into SSV. Out of the 4 cases (8.69%) of isolated DVT, the posterior tibial vein was involved in 2 limbs, anterior tibial and superficial femoral in 1 limb each. Thus, the present study localized thrombus predominantly in the thigh or popliteal region (79.15%). This finding is in accordance with the study conducted by *Markel et al.*<sup>14</sup> who concluded that proximal limb involvement was more common pattern of involvement as compared to the isolated calf DVT. *Moreno-Cabral et al.*<sup>15</sup> in their study found that the proximal deep vein thromboses had a greater chance of causing pulmonary thromboembolism as compared to below knee thrombi. Hence the identification of the iliofemoral

thrombi is of foremost importance.

The predominant stage of DVT in the cases showing evidence for thrombosis was that of the subacute stage seen in 24 cases (52.17%) in our study. These findings are similar to the study done by *Grosser et al.*<sup>16</sup> who found only 7 chronic cases by colour Doppler examination against 153 acute cases.

Complete thrombosis was observed in 31 patients (67.39%), while partial thrombosis was observed in 15 patients (32.60%). Most of the cases with complete thrombosis were of acute variety whereas incomplete thrombosis was predominated by the chronic cases. This is observed possibly due to the variable and gradual lysis of thrombus in most of the cases over a period of time<sup>17</sup>.

In our study, out of the 46 cases involved, 41 cases (89.13%) had multiple contiguous segmental involvement of the veins. Whereas 4 cases (8.69%) had isolated vein involvement. One case of multiple non-contiguous segmental involvement was noted. The study conducted by *Hill et al.*<sup>10</sup> in 1997 showed 34% cases had isolated thrombi confined to one venous segment, 52% thrombi were multiple contiguous type and 8% multiple non-contiguous type.

## CONCLUSION

Gray scale sonography findings together with colour doppler helps in evaluating the site, extent and stage of thrombus of the venous system of lower limbs. Duplex Doppler being a reliable, inexpensive and rapid first line investigation, can assist in early detection of DVT in clinically suspected cases.

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