

Original Article

Doppler Sonographic Evaluation of Venogenic Extremity Swellings: Analysis of 170 Patients from Kano, Nigeria

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ABSTRACT

Introduction: Deep venous thrombosis (DVT) is a serious problem that can potentially lead to many complications including life-threatening pulmonary arterial thrombosis. Screening and confirmation of the diagnosis are critical in the care of this condition. **Objectives:** The objective of this study was to evaluate the role of Doppler sonography in diagnosing DVT and to illustrate the pattern in 170 suspected cases from our local environment. **Materials and Methods:** This study was conducted at our department over 18 months. A total of 170 patients with clinical suspicion of limb DVT were recruited. The characteristics of the patients, risk factor for DVT, and the site of the lesion were documented. Sonographic examination was done using 7.5 MHz linear and 3.5 MHz convex transducers. **Results:** Out of the 170 patients, there are 89 (52.35%) males and 81 (47.65%) females. Their mean age was 50.6 years (+17.9 years). The common risk factors for DVT include chronic medical illness (28.8%), long distance travel (15.3%), previous DVT (8.8%), stroke/paralysis (5.3%), neoplasms (5.9%), pregnancy (5.9%), and trauma/surgery (5.9%). About 55.8% (95) of them were confirmed to have DVT on ultrasound while 44.2% (75) had normal ultrasound findings. There was a female preponderance among the 95 cases of DVT, 58.9% of them were females while 41.1% of them were males. It was found that contiguous femoro-popliteal and ilio-femoro-popliteal segments were most commonly thrombosed. These lesions were predominantly left sided (59.5%). **Conclusion:** There was a predominance of females and femoro-popliteal segments in DVT. Doppler ultrasound is very useful in the evaluation of extremity DVT. All clinically suspected cases should be evaluated with this modality due to limited sensitivity of clinical evaluation in the diagnosis of DVT. Further correlative studies in comparison to venography and hematologic indices are also recommended.

KEYWORDS: DVT, Doppler ultrasound, limb swelling

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INTRODUCTION

Deep venous thrombosis (DVT) is a common and serious medical problem, which may lead to many complications, including life-threatening pulmonary venous thrombosis. In the United States alone, as many as 100,000–180,000 deaths occur annually due to DVT and pulmonary embolism (PE).^[1]

There is a paucity of data from developing countries on the mortality rate from DVT and PE. However, a retrospective autopsy study from Nigeria showed a PE

prevalence rate of 2.9% with an increased risk for patients older than 40 years, males, and in those with cancer, multiple trauma, immobility and paralysis, septicemia, and major surgery.^[2] Venous ultrasonography has become a popular diagnostic modality for the diagnosis and exclusion of acute lower extremity DVT. Duplex ultrasound is considered as the primary noninvasive

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diagnostic method for DVT. As recommended by the Inter-societal Commission for the Accreditation of Vascular Laboratories, Doppler sonography should be the primary modality for peripheral venous examination.^[3]

Symptoms and signs are obviously inadequate alone for the evaluation of possible DVT, although some clinical presentations are more likely than others to be associated with DVT.^[3]

Wells *et al.*^[4] found that patients who present with at least one DVT risk factor and the classical symptoms of unilateral pain and swelling have an 85% probability of having DVT.

To some extent, venous thrombosis is considered as the disease of aging, with a low rate of about 1/10,000 annually before the fourth decade of life, rising rapidly after the age of 45 years, and approaching 5–6/1000 annually by the age of 80 years.^[5]

There is a paucity of data regarding the frequency, gender distribution, pattern of ultrasound findings in DVT, and common associated factors in our environment. Therefore, this study evaluates the role of Doppler sonography in the clinical management of suspected peripheral DVT and to illustrate the pattern in 170 suspected cases.

MATERIALS AND METHODS

This retrospective review was conducted at the vascular ultrasound clinic of Aminu Kano Teaching Hospital, Kano, Nigeria, from July 2012 to December 2014. A total of 170 consecutive patients with clinical suspicion of limb DVT were recruited. Using a structured data collection instrument, the sociodemographic characteristics of the patients, the clinical symptoms, risk factor(s) for the development of DVT, and the region of the examination were documented.

Thereafter, examination of the relevant limb (whether upper or lower; right or left) was done with the patient lying supine or prone (depending on the specific vein) using 7.5 MHz linear transducer connected to Mindray Digital Ultrasound Imaging System (Model DC-6; Shenzhen Mindray Biomed electronics, China). Occasionally, 3.5 MHz convex transducer of the same machine was used (to optimize the depth) in obese patients and those with severe subcutaneous edema and for the iliac vessels. Following application of water-soluble gel, ultrasound scan was started with gray scale mode to demonstrate the patency (or otherwise) of the lumen as well as compressibility and size of the vessel [Figure 1]. Power Doppler or color was done on the veins to document the presence (or absence) as well as the direction of blood flow [Figure 2]. Spectral

Doppler measurements were done on each of the major veins following application of sampling gate at the center of the color map of the vein. Furthermore, the lowest possible filter, the highest gain below noise level, and the smallest scale were selected to avoid aliasing. The peak of the Doppler waveforms was maximized to facilitate measurement. A spectral Doppler tracing was considered adequate when contiguous spectral tracings for at least five cardiac cycles were obtained. The venous wave was considered normal when it shows typical variations of flow velocities with respiration and positive responses to venous augmentation. The latter was done by demonstration of flow reversal on the venous Doppler waveform with squeezing of the calf musculature (or muscles of the fore arm) as shown in Figure 3. Any venous waveform without respiratory variation or response to augmentation was considered abnormal [Figures 4 and 5]. Corresponding arterial and soft tissue examinations were conducted for possible detection of incidental findings. All examinations were done by at least two consultant radiologists (at least one of the authors) with a minimum of 5-year postqualification experience and must have conducted more than 1000 peripheral vascular ultrasound examinations. The scans were done with patients lying calm on the examination table and each examination was conducted over a minimum of 20 min.

Results are presented numerically and tables, figures, and charts. Data analysis was conducted using Minitab statistical package, version 14.0 (Pennsylvania, United States) for Windows.

RESULTS

Out of the 170 patients, there are 89 (52.35%) males and 81 (47.65%) females. The ages of the

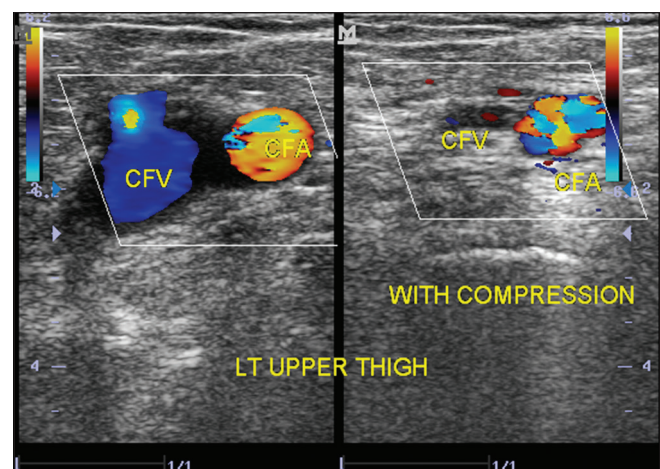


Figure 1: Axial section of color Doppler sonogram of the left groin/upper thigh showing normal compressibility of the common femoral vein, thus signifying a patent lumen

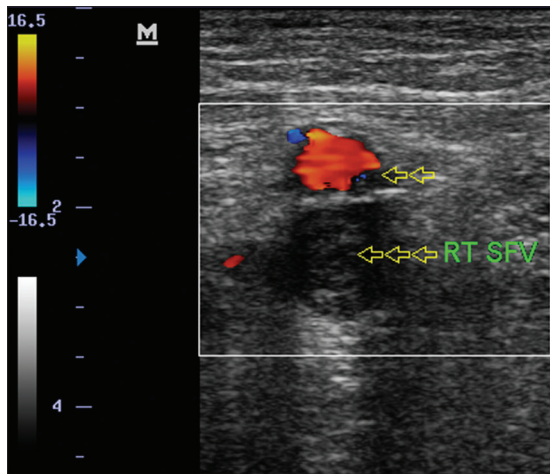


Figure 2: Axial section of color Doppler sonogram of the groin showing mixed echogenic luminal filling, rigidity, and absence of blood flow in the right superficial femoral vein in a patient with acute limb swelling

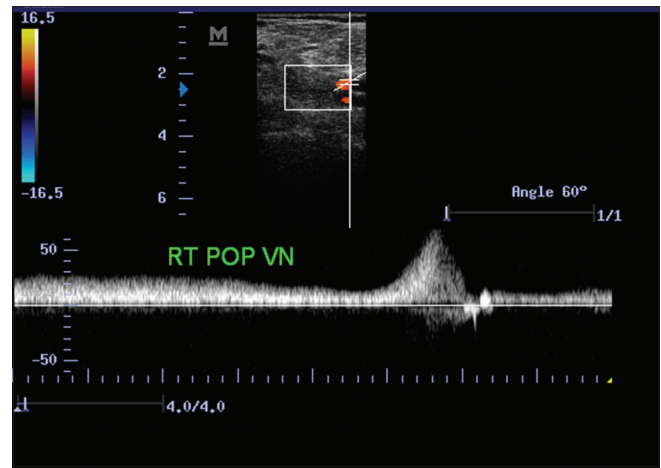


Figure 3: A spectral Doppler sonogram of the right popliteal vein showing normal respiratory variation and positive venous augmentation response

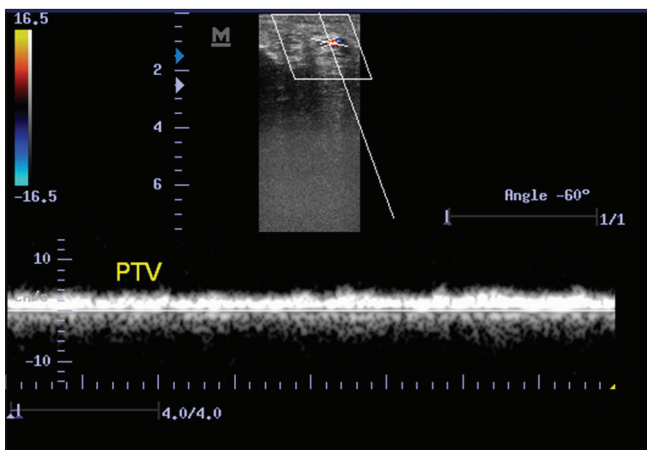


Figure 4: A spectral Doppler sonogram of the posterior tibial vein in a patient with partial femoro-popliteal thrombosis showing the absence of respiratory variation

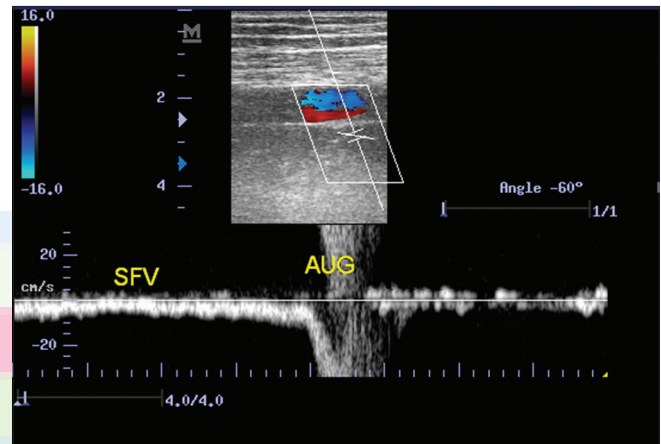


Figure 5: A spectral Doppler sonogram of the superficial femoral vein in a patient with ilio-femoral partial thrombosis. Note the positive augmentation response but without respiratory variation

patients ranged from 5 to 105 years, with a mean of 50.6 (+17.9 years). The mean age of the male patients was 53.4 years (+17.8 years) while that of females was 47.5 (+17.6 years). The mean age of those with deep vein thrombosis on ultrasound was 48.6 years (+17.6 years) while that of those with patent deep veins was 53.1 years (+18.1). However, the age differences between the two groups were not statistically significant ($P = 0.163$).

The common risk factors for DVT include [Table 1]: chronic medical illness (28.8%), long distance travel (15.3%), previous DVT (8.8%), stroke/paralysis (5.3%), neoplasms (5.9%), pregnancy (5.9%), and trauma/surgery (5.9%). As many as 25 patients (20.6%) did not have obvious risk factors for DVT. About 55.8% (95) of the study patients were confirmed to have DVT on ultrasound while 44.2% (75) were confirmed to have normal ultrasound findings (though two of them

had varicose veins with incompetent calf-perforating veins) [Table 2]. Table 5 showed that there is a greater female preponderance among the 95 cases of DVT, 58.9% of them were females while 41.1% of them were males. This difference was statistically significant ($\chi^2 = 3.984$, $df = 1$, $P < 0.05$). Those within the age range of 46–60 years have the highest prevalence of DVT, with 42 cases out of 95; while 0–15 years and 91–105 years have the least cases of one patient each. As shown on Table 3, the contiguous femoro-popliteal (34.7%) and ilio-femoro-popliteal (29.4%) segments were most commonly thrombosed while the subclavian (1.1%) and long saphenous veins (1.1%) were least involved. These lesions were more on the left side (50.5%). The right-sided lesions were seen in 30.5% while 19.0% of them had bilateral lesions [Table 4]. These differences were statistically significant ($\chi^2 = 12.866$, $df = 2$, $P = 0.002$). When the abnormalities of venous waveforms of those with DVT were compared to the

Table 1: The identifiable risk factors in the study population

Risk factor	Frequency (%)
Stroke/paralysis	9 (5.3)
Abdomino-pelvic masses	6 (3.5)
Pregnancy	10 (5.9)
Previous DVT	15 (8.8)
Trauma/surgery	10 (5.9)
Chronic medical illness (e.g., chronic kidney disease, diabetes, and hypertension)	49 (28.8)
Long distance travel	26 (15.3)
Neoplasm	10 (5.9)
Nil	35 (20.6)
Total	170 (100.0)

DVT=Deep venous thrombosis

Table 2: Age distribution of the patients

Age group (years)	DVT	Normal	Others	Total
0-15	1	1		2
16-30	15	10	Varicose veins	26
31-45	21	11	Varicose veins	33
46-60	42	28		70
61-75	9	13		22
76-90	6	10		16
91-105	1	0		1
Total	95	73	2	170

DVT=Deep venous thrombosis

Table 3: Anatomic venous involvement in deep venous thrombosis

Vein	Frequency (%)
Subclavian	5 (5.3)
Subclavian and brachial	1 (1.1)
Axillary and brachial	2 (2.1)
Ilio-femoro-popliteal	28 (29.4)
Femoro-popliteal	33 (34.7)
Popliteal	19 (20)
Popliteal and tibial	6 (6.3)
Long saphenous	1 (1.1)
Total	95 (100)

Table 4: Side of involvement in deep venous thrombosis

Side	Frequency (%)
Right	29 (30.5)
Left	48 (50.5)
Bilateral	18 (19)
Total	83 (100)

Doppler diagnosis, a statistically significant correlation was found between the two variables ($\chi^2 = 162.185$, $df = 2$, $P = 0.000$). Incidental findings include femoro-popliteal arteric atherosclerosis (20 cases), arterial stenosis (10 cases), arrhythmia (14 cases), and cellulitis (8 cases); while no incidental sonographic

Table 5: Gender distribution of the Doppler sonographic findings

Gender	DVT	Normal	Others	Total
Males	39	48	2	89
Females	56	25	0	81
Total	95	73	2	170

$\chi^2=3.984$, $df=1$, $P<0.05$. DVT=Deep venous thrombosis

Table 6: The Doppler waveforms of the study patients

	Normal/patent veins	DVT	Total
Normal waveform	75	2	77
Abnormal waveform	0	26	26
Absent flow/waveform	0	67	67
Total	75	95	170

$\chi^2=162.185$, $df=2$, $P=0.047$. DVT=Deep venous thrombosis

finding was identified in the extremity vessels of 58 patients.

DISCUSSION

Over the years, managing physicians are concerned about the low sensitivity of clinical diagnosis in DVT because the symptoms or signs of venous thrombosis can be caused by nonthrombotic disorders. This concern is because many potentially dangerous venous thrombi are clinically silent.^[6] From their study on suspected cases of DVT, Agunloye *et al.* showed that the clinical signs of DVT were positive in only 46.6% following Doppler sonography.^[7] This is slightly lower than the findings in this study of 55.8%. On the other hand, a Brazilian study on 528 suspected cases by Baroncini *et al.* found a lower value of 34.6%.^[8] These variations could be from differences in sample sizes and local patterns on the incidences of DVT and operator expertise in diagnosing DVT with Doppler sonography.

The study also showed that patients aged 46–60 years have the highest prevalence of DVT compared to other age groups ($P = 0.163$). These are slightly younger than 61–80 years recorded by Agunloye *et al.*^[7] in southwestern Nigeria. Although the two studies were done in the same country, regional differences in life expectancy and prevalence of the risk factors could have accounted for the variation. On the other hand, Baroncini *et al.*^[8] found sonographically confirmed DVT to be more common in those older than 65 years. Other reports also showed that the 8-year rate of DVT in those aged 85 years and older at baseline was 13 fold greater than in those aged 45 years.^[4] This is as a result of higher prevalence of risk factors and other compounding medical conditions, this pattern of increasing incidence of DVT with age is corroborated by many studies.^[1,4,5,7]

The significantly higher female preponderance among the 95 cases of DVT in this study differs from many other reviews that showed no significant gender predilections for DVT.^[4,9] Nevertheless, some gender-specific risk factors (such as pregnancy, oral contraceptive pills, hormone replacement therapies, and pelvic masses) could make women more predisposed than men to DVT. It was found that there are more women (than men) with DVT in younger patients when these risk factors are frequent.^[10] On the other hand, greater male preponderance was observed in older patients, probably because the risk factor of pregnancy has been eliminated.^[4]

In this study, the predominant risk factors for DVT are mainly those that cause stasis in the vascular system and this corroborates the findings of Ouriel *et al.*^[11] on 2762 venograms performed in 2541 patients over a 10-year period, where they found 344 cases (39%) to be idiopathic, 307 cases (35%) postoperative, 84 cases (10%) occurred in the setting of malignancy, and 70 cases (8%) occurred as a result of trauma. Although malignancies carry greater percentage, similar preponderance of cancers was also reported by Baroncini *et al.*^[8] On the other hand, a review of 22 cases of DVT from Maiduguri (northeastern Nigeria) by Ahmed *et al.*^[12] showed a slightly different pattern; with obesity accounting for 68% of patients, abdominal surgery 27%, pelvic surgery 23%, advancing age 18% while puerperium constituted 18%. This variation could be from their smaller sample size. Nevertheless, they also reported a case of DVT in patients with human immunodeficiency viral infection, sickle cell disease, and another with systemic lupus erythematosus. Irrespective of the variability of the prevalence of risk factors from different environments, majority of them were predisposed to DVT by causing stasis in the venous system as postulated by Rudolf Virchow. In fact, his close association with the Virchow's triad should therefore continue as acknowledgment of his pioneering work in the thrombotic process, particularly as the triad remains so clinically relevant today.^[13]

The predominance of femoro-popliteal and ilio-femoral involvement in this study agrees with those of Agunloye *et al.*^[7] from Ibadan (Nigeria) and Baroncini *et al.*^[8] from Brazil, but differs from the findings of Ouriel *et al.*^[11] on 2762 venograms, where they found a high frequency of peroneal vein thrombosis (67%). This variation could have been due to differential sensitivities of the ultrasound and venography, sample sizes, and possible environmental factors. In addition, the left-sided preponderance of lower limb DVT in this study ($P = 0.002$) agrees with many studies.^[4,7,10] According to Thijs *et al.*,^[14] there is a clear predominance of left-sided versus right-sided

DVT, which is not affected by DVT risk factors. Thus, compression of the left common iliac vein with the right common iliac artery remains the only plausible explanation for the predominance of left-sided DVT.

Furthermore, the close association between the waveform abnormalities and the diagnosis of DVT ($P = 0.000$) underscores the value of spectral Doppler sonography in the evaluation of suspected DVT [Table 6, Figures 4 and 5]. As highlighted by Zierler,^[3] the high specificity of venous ultrasonography allows the treatment of DVT to be initiated without further confirmatory tests, and the high sensitivity in diagnosing proximal DVT makes it possible to even withhold treatment if the examination is negative.

The presence of incidental vascular sonographic findings in about 30% of our study population signifies the relevance of comorbidities in DVT, especially in older patients. Since this will influence the overall care, such suspected patients with DVT should be thoroughly evaluated for possible existing arterial and cardiac disease.

CONCLUSION

This analysis of 170 suspected cases of DVT by Doppler sonography in our environment showed the value of Doppler sonography in screening these patients. The pattern of DVT in our setting showed greater female preponderance and left-sided involvement as reported by other researchers. In addition, the contiguous thrombosis of ilio-femoral and femoro-popliteal segments was most commonly encountered in our setting. Therefore, Doppler sonography is recommended for all cases of limb swelling, especially those with risk factors for DVT due to limited sensitivity of clinical evaluation in the diagnosis of DVT. Further, correlative studies with venography and hematologic indices are also recommended.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Buckner TW, Key NS. Venous thrombosis in blacks. *Circulation* 2012;125:837-9.
2. Sotunmbi PT, Idowu AT, Akang EE, Aken'Ova YA. Prevalence of venous thromboembolism at post-mortem in an African population: A cause for concern. *Afr J Med Med Sci* 2006;35:345-8.
3. Zierler BK. Ultrasonography and diagnosis of venous thromboembolism. *Circulation* 2004;109 12 Suppl 1:19-4.
4. Wells PS, Hirsh J, Anderson DR, Lensing AW, Foster G, Kearon C, *et al.* Accuracy of clinical assessment of deep-vein

- thrombosis. *Lancet* 1995;345:1326-30.
- Cushman M. Epidemiology and risk factors for venous thrombosis. *Semin Hematol* 2007;44:62-9.
 - Hirsh J, Hull RD, Raskob GE. Clinical features and diagnosis of venous thrombosis. *J Am Coll Cardiol* 1986;8 6 Suppl B: 114B-27B.
 - Agunloye MA, Akinmoladun JA, Ogbale GI, Akingbola T, Adeyinka AO. The role of Doppler ultrasound in clinically suspected deep vein thrombosis of the lower limb in black African population. *West Afr J Ultrasound* 2010;11:1-10.
 - Baroncini LA, França GJ, de Oliveira G, Vidal EA, Del Valle CE, Stahlke PS, *et al.* Correlation of clinical features with the risk of lower limb deep vein thrombosis assessed by duplex ultrasound. *J Vasc Bras* 2013;12:118-22.
 - White RH. The epidemiology of venous thromboembolism. *Circulation* 2003;107 23 Suppl 1:14-8.
 - Moores L, Bilello KL, Murin S. Sex and gender issues and venous thromboembolism. *Clin Chest Med* 2004;25:281-97.
 - Ouriel K, Green RM, Greenberg RK, Clair DG. The anatomy of deep venous thrombosis of the lower extremity. *J Vasc Surg* 2000;31:895-900.
 - Ahmed SG, Tahir A, Hassan AW, Kyari O, Ibrahim UA. Clinical risk factors for deep vein thrombosis in Maiduguri – Nigeria. *Highland Med Res J* 2003;1:9-16.
 - Bagot CN, Arya R. Virchow and his triad: A question of attribution. *Br J Haematol* 2008;143:180-90.
 - Thijs W, Rabe KF, Rosendaal FR, Middeldorp S. Predominance of left-sided deep vein thrombosis and body weight. *J Thromb Haemost* 2010;8:2083-4.

