

Duplex ultrasound: Indications and findings in a newly created facility at the University of Calabar Teaching Hospital, Calabar

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Abstract

Background: Peripheral limb vascular diseases form one of the most common diseases that affect the middle-aged and the elderly. Duplex ultrasound has revolutionized medicare and is an important modality for investigating them. Unfortunately, this modality is still not popular in our environment and in Calabar was used for the 1st time 4 years ago. This work is, therefore, to report our findings and hopefully increase the awareness of its benefits thereby improving and hastening the diagnosis of vascular pathologies in our environment.

Methods: A prospective study that took place in the University of Calabar Teaching Hospital, Calabar between March 2011 and August 2014. The study included patients with pain, swelling, ulceration, as well as outright gangrene of the upper or lower limbs. Others were stroke or transient ischemic attack (TIA) patients, and patients with renal grafts. The scans were carried out in Radiology Department using a digital color Doppler ultrasound.

Results: Seventy-six patients were scanned during this period. They were more males (67%) than females (33%). The indications were mainly leg swelling and pain 25 (33%), stroke/TIA 10 (13%), and deep venous thrombosis (DVT) 10 (13%). The most common scan done was peripheral limb Doppler, 49 (64.5%). The majority of the scans showed no abnormality followed by chronic venous insufficiency 13 (17.1%) and lower limb arteriosclerosis 7 (9.2%) which was noted to be common among diabetics and hypertensive. DVT was another common finding and 4 out of 10 patients in whom DVT was suspected clinically showed sonographic evidence of the condition.

Conclusion: Duplex ultrasound has been shown to diagnose varied vascular pathologies even in a locale where it is a relatively new technique. It is recommended that timely referrals be made, and mobile Doppler units be acquired to save more lives and limbs in the developing world.

Key words: Calabar, deep venous thrombosis, duplex ultrasound, peripheral lower limbs

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Introduction

Peripheral limb vascular diseases form some of the most

common diseases that affect the middle-aged and the elderly.^[1] In the United States, they are said to affect over 12–20% of people aged 65 years and above.^[2] They affect men and women equally.^[3] Common vascular diseases in this age group include chronic venous insufficiency (CVI), deep venous thrombosis (DVT), vascular aneurysms, and

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atherosclerosis.^[3] The risk factors include increasing age, smoking, diabetes mellitus (DM), obesity, hypertension, malignancy, and dyslipidemia.^[3]

Doppler ultrasound is a special ultrasound technique that evaluates blood flow through blood vessels. It is safe, painless, cost-effective, and images are acquired and interpreted real time thereby making it ideal for emergencies.^[4] Unfortunately, in our environment this was not available until recently. These patients were, therefore, managed with only clinical assessment of their blood vessels and X-rays. With the arrival of a Doppler scan 3 years ago in Calabar it has become possible to evaluate patients with suspected vascular pathologies with this modality. It is hoped that this study will not only outline the benefits to patients but will also showcase this relatively new technique to physicians, surgeons, and orthopedists practicing in this city, and its environs and encourage them to use it.

Methods

This was a prospective, descriptive study that took place at the Radiology Department of the University of Calabar Teaching Hospital between March 2011 and August 2014 where all patients from internal medicine, general surgery, and orthopedic clinics and wards with symptoms ranging from pain, swelling, discoloration, or chronic ulcerations of their limbs are referred for investigations. Others were referred for follow-up of their renal grafts; still others came with outright upper or lower limb gangrene and to ascertain the cause of stroke or transient ischemic attack (TIA). All patients had history and physical examination of their peripheral pulses done and then offered Doppler scan. This was a review study without invasive intervention and, therefore, did not require ethical approval. They were scanned in the supine or erect position. The equipment used was a four-dimensional digital Doppler ultrasound sonoscape 6000 sonographic scanner using a 7.5 MHz probe for superficial veins, and 6 MHz for deeper veins. Abdominal vessels were scanned with 3.5 MHz probe. Each patient had color flow (which shows the overall view of flow in a region), spectral flow (which gives details of the velocity of flow), and power also called energy Doppler (which improves sensitivity to slow flow).

Since most referrals were for peripheral limb Doppler studies, further and more in-dept analysis was done for this group of patients. The diagnosis was made by their meeting the diagnostic criteria.^[5-7] All Doppler scans were carried out and interpreted by two consultant radiologists first independently and later collated for easier analysis.

The collected data were analyzed using SPSS 20 Inc, Chicago, IL USA. Frequency tables and bar charts were used to analyze the data.

Results

Seventy-six patients participated in the study, of these 51 (67%) were males, 25 (33%) were females. Their ages ranged from 0.33 years to 87 years with a mean of 48.53 (standard deviation 17.93) years. The common indications included leg swelling and pain 25 (33%), stroke/TIA 10 (13%), DVT 10 (13%), and ulcers 8 (11%) [Figure 1]. The common types of Doppler studies were peripheral limb studies 49 (4.47%) and carotid Doppler 14 (18.42%) [Table 1].

The majority of the studies were normal 25 (32.9%). CVI 13 (17%) and lower limb arteriosclerosis 9 (9.2%) were the most common Doppler findings [Table 2].

Table 3 shows a comparison of clinical diagnosis with Doppler findings. Four out of the 10 patients who presented with clinical features of DVT actually showed sonographic findings of DVT. Diabetics and hypertensive patients were noted to have arteriosclerosis of their peripheral limb vessels, but secondary stenosis of these vessels were seen only in diabetics.

Table 1: Types of duplex ultrasound examination

Duplex ultrasound examination	Frequency	Percentages
Peripheral lower limb	49	64.47
Peripheral upper limb	2	2.63
Carotid	14	18.42
Renal	6	7.90
Scrotal	4	5.26
Abdominal aorta	1	1.32
Total	76	100

Table 2: Duplex ultrasound findings

Duplex ultrasound findings	Frequency	Percentages
CVI	13	17.1
Lower limb arteriosclerosis	7	9.2
Carotid arteriosclerosis	2	2.6
Peripheral arteriosclerosis/stenosis	1	1.3
Carotid arteriosclerosis/stenosis	2	2.6
Lower limb arterial stenosis	3	3.9
Deep vein thrombosis	3	3.9
Deep vein thrombosis/arteriosclerosis	1	1.3
Thrombophlebitis	1	1.3
Renal artery stenosis	3	3.9
Epididymo orchitis	3	3.9
Lower limb varicose vein	1	1.3
Resolving lower limb hematoma	1	1.3
Brachial artery aneurysm	1	1.3
Cellulitis	1	1.3
Buruli ulcer	2	2.6
Amniotic band	1	1.3
Normal	25	32.1
Others	5	6.6
Total	76	

CVI=Chronic venous insufficiency

Table 3: Duplex ultrasound findings in various clinical conditions

Clinical indications	Duplex ultrasound findings					
	Normal n (%)	DVT n (%)	Gangrene n (%)	Arteriosclerosis n (%)	Arteriosclerosis and stenosis n (%)	CVI n (%)
Diabetes (8)	0 (0)	1 (12.5)	1 (12)	3 (37)	2 (25)	0
Hypertension (5)	2 (40)	0 (0)	0 (0)	2 (40)	0 (0)	1 (20)
Ulcers (7)	3 (42)	0 (0)	0 (0)	1 (15)	0 (0)	1 (15)
DVT (10)	3 (30)	4 (40)	0 (0)	0 (0)	0 (0)	3 (30)
Stroke/TIA (10)	5 (50)	0 (0)	0 (0)	3 (30)	2 (20)	0 (0)

DVT=Deep venous thrombosis; TIA=Transient ischemic attack; CVI=Chronic venous insufficiency

Table 4: Relationship of major duplex ultrasound findings with age, gender and clinical information

Duplex ultrasound findings	Number	Male (%)	Female (%)	Age (%)		Clinical information	
				>50	<50	Hypertension	Diabetes
CVI	13	7 (54)	6 (46)	8 (62)	5 (38)	1	0
Atherosclerosis	15	10 (66)	5 (33)	13 (87)	2 (13)	1	5

CVI=Chronic venous insufficiency

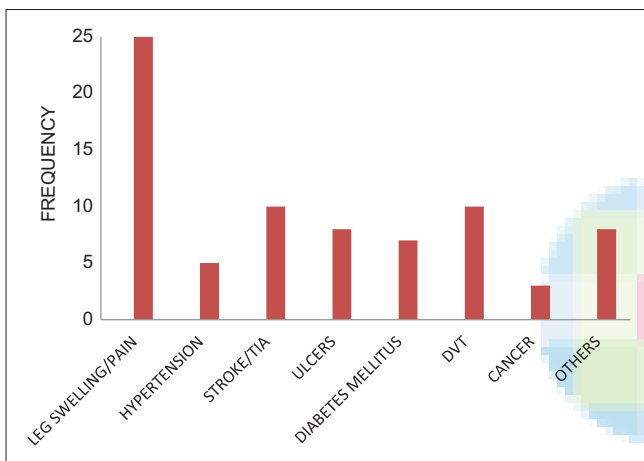


Figure 1: Clinical indications for duplex ultrasound examination

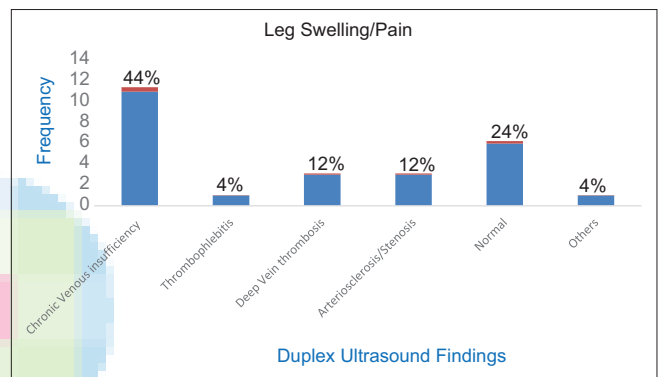


Figure 2: Duplex ultrasound findings in leg swelling and pain

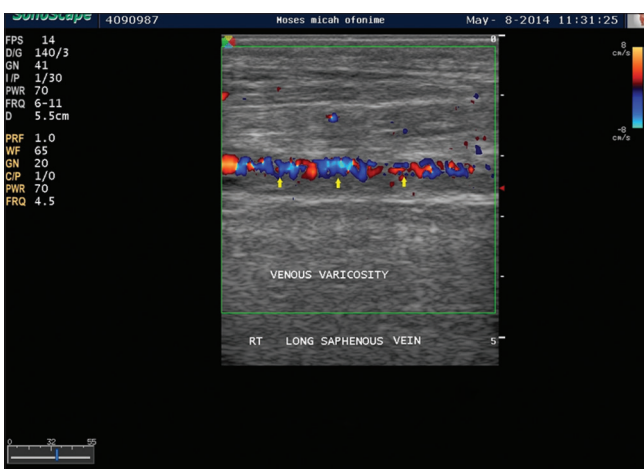


Figure 3: Varicose veins in the right long saphenous vein

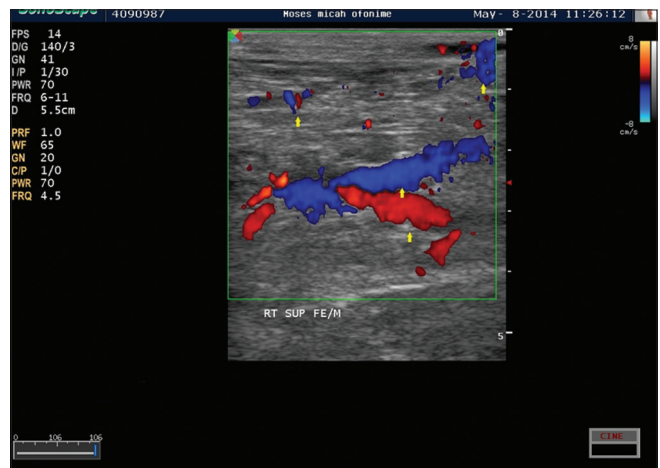


Figure 4: Enlarged right saphenous veins with several tributaries in a patient with Klippel-Trenaunay syndrome

Since leg swelling and pain were the most common indications for referral, sonographic findings in them were further analyzed. A significant number of these patients was found to have CVI and while a large number (24%)

showed no abnormality [Figure 2]. Table 4 relates some major Doppler findings with age, gender, and clinical history of hypertension and diabetes. CVI and atherosclerosis were more common in men above 50 years, and atherosclerosis more common in diabetic patients.

Figures 3 and 4 show color Doppler images of dilated right lung saphenous veins with several tributaries and varicose veins along the right lung saphenous veins in a patient with Klippel–Trenaunay syndrome.

Discussion

Clinical practice has evolved rapidly because of the introduction of medical Doppler imaging.^[5] Indications for Doppler imaging range from stroke, renal artery diseases, lower limb swelling and pain, especially to rule out DVT and outright gangrene to ascertain the cause and the level of involvement. Medical Doppler Imaging came into existence about 28 years after the introduction of ultrasound in the 1940s.^[5] Unfortunately, it has taken about 40 years for its use to reach Calabar and its environs.

The index study has shown that only 76 patients were evaluated over 3 years. This indicates a low level of awareness among clinicians in the environment. The male preponderance is similar to other studies done within the country such as that by Misauno *et al.*^[8] done in the University of Jos Teaching Hospital that showed 86 (52.1%) males and 19 (47.9%) females and that done by Ose-Emenim and Usuanle^[9] at the University Teaching Hospital, Benin that showed a slight male preponderance of 50.4%. This may be explained by the fact that males tend to seek medical care more frequently than women since they are supposed to be bread winners and, therefore, more fearful of the outcome of their condition. Leg swelling and pain, stroke/TIA, DVT, and ulcers were the most common clinical indications. This is unlike the study done in Jos University Teaching Hospital by Misauno *et al.*^[8] which showed that DVT, peripheral vascular disease, and vascular aneurysms in that order were the most common indications. However, a study done by Ose-Emenim and Usuanle^[9] revealed that the most common indication for Doppler interrogation of the lower limb was leg swelling.

The most encountered type of Doppler studies in this study was peripheral limb Doppler studies. This pattern was noted in similar studies done in the country.^[8,9] This could be explained by the fact that only Doppler studies can adequately detect vascular abnormalities while the other abnormalities could be detected by other imaging modalities like X-rays and ultrasound.

The index study revealed that majority of the scans done was normal, while the most common findings included CVI, atherosclerosis, and DVT. This pattern was noted by Ose-Emenim and Usuanle in Benin. The number of patients who had DVT was significant. A similar study done in Lagos University Teaching Hospital by Olowoyeye *et al.*^[10] revealed that of the 70 patients with clinical

diagnosis of DVT, 42.3% actually had acute DVT. These high prevalence rates of DVT contradict previous belief that in low-income countries, particularly in Africa, venous thromboembolism is seldom diagnosed, and conscious measures for its prevention, diagnosis, and treatment are seldom instituted.^[11,12] The ideal or gold standard for diagnosis of DVT is ascending contrast venography.^[5,13] Unfortunately, it is not readily available in low-income countries. The diagnosis of acute DVT requires the disproof of venous patency which is the inability of veins to collapse on compression. Direct visualization of the thrombus via echogenicity and abnormal color flow pattern are other less diagnostic criteria.^[5,13-15] These are easily carried out on duplex scan even though it is highly operator dependent. This was checked by the scans being carried out independently by two radiologists.

CVI was another common finding just as in other parts of the world.^[16] These patients present with pain and swelling^[16] which could be frightful when it becomes massive. Our study revealed that most of these patients were in the elderly age group and that it was more common in males, hypertensives and diabetics. Florea *et al.*^[17] showed DM to be a very important contributory factor to the development of CVI. In the index study, atherosclerosis was also noted to be quite common, affecting commonly males above 50 and diabetics. This can be explained by the fact that the most common macro vascular manifestation of DM is atherosclerosis.^[18] The key to making a precise diagnosis is in recognizing the characteristics of various diseases on ultrasound images. Ideally, these scans should be carried out at the patient's bedside. Mobile Doppler scan units are yet to be available in the wards or the emergency rooms of our hospital. Delayed evaluation may, therefore, have resulted in resolved lesions leading to false negatives which would be documented as normal studies.

Conclusion

Duplex ultrasonography is a recently introduced imaging modality in Calabar and its environs. Despite the limited experience, it has contributed significantly to the diagnosis of vascular lesions in this environment. It is, therefore, recommended that tertiary institutions such as ours acquire mobile Doppler ultrasound units. It is also advisable that our physicians and surgeons be aware of the many benefits of Doppler studies in the diagnosis and follow-up of their patients.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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