Evaluation of patterns of venous reflux on duplex scan and its clinical significance in a Caribbean population-a prospective study

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Abstract:

Purpose: The purpose of this paper is to identify the major anatomic areas of venous reflux in the lower limb and determine how these correlate with signs of severe venous disease such as lipodermatosclerosis and venous ulceration**.**

Methods: Patterns of venous reflux were prospectively examined in 284 consecutive patients (423 limbs) attending a specialist venous clinic over a period of 3 years, using a color-coded duplex scan and comparing these with the clinical presentation of the patients, to identify how these were related to the sites of major reflux in the lower limb.

Results: Of all limbs scanned, the majority showed reflux at the sapheno-femoral junction. Primary, uncomplicated veins were associated mainly with superficial venous reflux (54%) as compared with deep reflux (8%) or mixed superficial and deep (4%).

In complicated venous disease, lipodermatosclerosis was associated with superficial reflux twice as often as deep reflux (5.2% v 2.6%) and venous ulcers were more likely to

be as a result of deep reflux (5.9%) when compared with cases of superficial reflux (3.3%) or both (1.2%).

Conclusions: The presence of venous ulcers was more likely in patients with deep venous reflux and lipodermatosclerosis was more common in limbs with superficial venous reflux.

Introduction:

Lipodermatosclerosis (LDS) and leg ulcers are two of the common and significant complications of venous disease that represent Clinical Classes IV, V and VI of the CEAP classification for venous disease. They are cosmetically alarming, socially unacceptable, painful and distressing to patients, usually requiring immediate referral to a specialist surgical clinic for successful treatment.

The pathology of valvular disease leading to reflux can be seen at the major venous junctions mainly at the Sapheno-femoral and the Sapheno-popliteal junctions as well as along the long saphenous vein, the thigh and calf perforators and the deep veins. The presence and degree of reflux can then be demonstrated by imaging these areas using a color-coded Doppler-Ultrasound (Duplex) scan. Exactly how the degree of reflux correlates with the presence of Lipodermatosclerosis (LDS) and Venous ulceration in a Caribbean population is unknown.

Is there a correlation between either superficial or deep reflux or the presence of Lipodermatosclerosis (LDS) or venous ulceration and is this more prominent in the female or male patient population? This study looks at the combination of the various sites of reflux and their link in causing Lipodermatosclerosis (LDS) or venous ulceration in Caribbean population.

Patients and Methods:

Patients were chosen prospectively from a single surgeon practice at a specialist clinic. They were seen over a period of three (3) years, with 372 consecutive patients having venous disease. Informed consent was obtained from all patients. Patients were examined clinically and veins were classified according to whether they were spider or reticular veins (88) classified as clinical class C-1 based on the CEAP classification[1], or related to the long or short saphenous venous systems. The method of examination and the clinical features were adopted from the CEAP classification[2], with a comparison to the previously used Basle Study[3,4] . Investigations were done to determine whether these veins had reflux at the sapheno-femoral junction (SFJ), along the long saphenous system or reflux at the sapheno-popliteal junction (SPJ) as well as the deep venous system.

In-depth interrogations with a color-coded duplex scan was used and spectral duplex scan performed by a radiologist who is a post-graduate trained specialist using a GE (General Electric) Logic P5 10 MHz Linear Probe was used 5 to determine whether there were incompetent perforators in the calf region and to ascertain if the deep veins of the calf

were incompetent. An attempt was then made to correlate trends between the presence of venous ulcers and the level(s) of incompetence demonstrated as well as presence of lipodermatosclerosis (LDS).

TABLE I:

	Patients	Limbs
Unilateral	145	145
Bilateral	139	278
Total, Number	284	423

Total Limbs: M=56, F=228

A total of 423 limbs from 284 patients (145 unilateral and 139 bilateral) were evaluated (Table I) to determine the frequency of incompetence at the sapheno-femoral junction (SFJ) and the sapheno-popliteal junction (SPJ) and whether these major levels of incompetence correlated with the presence of venous ulceration or lipodermatosclerosis (LDS). The deep veins of the limbs were also evaluated by duplex interrogation to see if there was any evidence of deep venous incompetence or deep venous thrombosis. These were then gender matched to identify any differences with respect to ulcers, LDS and competence levels.

Results:

A total of 423 limbs were assessed in 284 patients; of which 228 were female and 56 were male (Table I). Of the 423 limbs assessed, 300 (71%) were found to have reflux at

one of the levels under investigation and data were incomplete with respect to clinical stage or presence of varicose veins, lipodermatosclerodsis and ulcers in 35 limbs (Table II) and eighty-eight were classified as CEAP [1] clinical class 1,and were not included in the study which was not intended to be a morphological or epidemiologic study but a look at varicose veins, its complications and how this relates to reflux at different anatomical levels. This left three hundred limbs for duplex analysis. There was a female predominance with the original number of patients having a 4:1 ratio of women to men. Reflux by level of incompetence in the venous system is demonstrated in Table III. All limbs did not routinely have all six levels of venous mapping due presumably to time constraints but this table includes all limbs with venous class C2 to C6 in the CEAP classification which corresponds to Basle grade 2 and 3.

TABLE II: The Clinical Class of Veins

N=423 Patients-284 Male 56 Female 228

Clinical Class	Number	Percentage
Undiagnosed	35	8
CEAP 1	88	21
C2	128	31
C3	89	20
C4	139	39
C5	24	24
C6	20	20

TABLE III: Venous Reflux with Levels of Incompetence

Level of Reflux	Limbs	Percentage
Sapheno-femoral (SFJ)	224	75%
Sapheno-popliteal (SPJ)	24	8%
Deep venous (DVI)	52	17%

On examination of the 300 limbs, the major area of reflux was seen at the sapheno-femoral junction (SFJ) 75%, with the SPJ (8%) and DVI (17%) accounting for much less (Table III).The SFJ demonstrated the highest level of isolated superficial reflux (Table IV) 68% whilst isolated deep vein reflux occurred in only 12% in our series. Total superficial venous reflux accounted for 53% of limbs scanned with 48% of limbs having isolated SFJ reflux.

Complications of varicose veins such as lipodermatosclerosis (CEAP class IV) and venous ulcers (CEAP class V and VI) were then matched with the level of incompetence detected on duplex scanning to see what relationship existed. In all (Table V), only 13.7% of limbs (39/284) presented with lipodermatosclerosis (LDS) and a similar number 15.4% (44/284) presented with venous ulceration.

TABLE IV: Reflux in Superficial Veins compared with Deep Veins

Level of Incompetence	Limbs	% of Reflux	% of Limbs
Isolated SFJ	204	68%	48%
Isolated SPJ	19	6%	5%
Total Superficial	223	74%	53%
Isolated DVI	35	12%	8%

TABLE V: Lipodermatosclerosis (LDS) related to Level of Incompetence and Gender

N=39 Limbs=300 (13.0%)

Level of Incompetence	Number	% LDS
Isolated SFJ reflux	20	51%
Isolated DVI	11	28%
Isolated SPJ	1	3%
SFJ+SPJ	1	3%
SFJ+DVI	5	12%
SPJ+DVI	1	3%

Gender	N	Percentage
Male	10	25.6%
Female	29	74.4%

When limbs with LDS were examined with the duplex scan, 51% were found to have isolated SFJ reflux, 28% with isolated deep venous reflux (DVI) and 3% with SPJ reflux, however the combination of SFJ and DVI reflux still accounted for 12% indicating that although LDS was far more likely to be due to superficial rather than deep incompetence, one out of every eight patients with LDS had both superficial and deep components of reflux present.

In patients with venous ulcers (44 ulcers- 15.4%), 57% of these patients had isolated DVI, 32% had superficial venous reflux (mainly at the SFJ) and 11% had a mixture of superficial and deep venous reflux and there were more females with ulcers (70.5%) than males (29.5%). (Table VI)

TABLE VI: Prevalence of Ulcers related to Level of Incompetence, Gender

Number of Venous Ulcers= 44, Number of patients= 284 (15.4%)

Level of Incompetence	Number	Percentage
Isolated Deep Venous Reflux	25	57%
Deep and Superficial Reflux	5	11%
Superficial Venous Reflux	14	32%

Gender	N	Percentage
Male	13	29.5%
Female	31	70.5%

With regard to all limbs with primary varicose veins, lipodermatosclerosis and venous ulceration, superficial reflux alone was seen in 54%, 5.2% and 3.3%, deep venous reflux in 8%, 2.6% and 5.9% and both superficial and deep reflux in 4%, 1.4% and 1.2% of limbs respectively. (Table VII).

TABLE VII: Sites of Reflux related to Severity of Venous Disease

Site of Reflux	Uncomplicated Veins LDS	Complications of Venous Disease Venous Ulcers	
Superficial Reflux	227 (54%)	22 (5.2%)	14 (3.3%)
Deep Reflux	35 (8%)	11 (2.6%)	25 (5.9%)
Sup.+ Deep Reflux	17 (4%)	6 (1.4%)	5 (1.2%)

In the limbs with superficial venous reflux the sapheno-femoral junction alone was involved in 48%, 5% and 3% of primary varicose veins, lipodematosclerosis and venous ulcers, the sapheno-popliteal junction alone in 5%, 0.2% and 0.2% and both the sapheno-femoral and sapheno-popliteal junctions in 1%, 0.2% and 0%.

Overall, the venous class varied with level of reflux, class 0 1,2,3, having <1%, 48%, 5% and 3% SFJ reflux related to the long saphenous system (respectively) and <1%, 5%, 0.2% and 0.2% SPJ reflux related to the short saphenous venous system.

When superficial and deep systems were compared, isolated SFJ reflux was noted in 68% of patients (with reflux), isolated sapheno-popliteal junction (SPJ) reflux just 6% of patients (with reflux) whilst isolated deep vein incompetence (DVI) accounted for 12% reflux. Skin changes, particularly the peri-malleolar hyper pigmentation seen in lipodermatosclerosis (LDS) are noted as a relatively common complication of venous disease. In our series lipodermatosclerosis (LDS), was seen in 13.7% of patients (Table V). The majority of these limbs demonstrated isolated SFJ reflux (51%), followed by isolated deep vein incompetence (28%) and the combination SFJ/ DVI accounting for even less reflux (12%).

The sites of reflux were then compared with the severity of venous disease (Table VII) and this indicated that primary varicose veins were mainly as a result of superficial venous reflux (54% limbs) with deep reflux accounting for less than ten percent (8%) and the combination of both superficial and deep even less (4%).

TABLE VIII: Superficial Venous Reflux and Severity of Venous Disease

Site of Reflux	Primary varicose Veins	LDS	Venous Ulcers
SFJ	204(48%)	20(5%)	13(3%)
SPJ	19(5%)	(0.2%)	1(0.2%)
SFJ+SPJ	4(1%)	(0.2%)	0

SFJ = Sapheno-femoral junction; SPJ= Sapheno-popliteal junction.

When superficial venous reflux (Table VIII) was subdivided into its different components the relationship with varicose veins, LDS and ulcers becomes apparent. In these limbs with superficial venous reflux we noted reflux at the sapheno-femoral junction (SFJ) was involved in 48% of uncomplicated varicose veins. This indicates that the SFJ has an important role in the appearance of varicose veins in our patient population and, not surprisingly, is responsible for a significant number of all limbs that were scanned

Discussion:

The relation between clinical severity of venous disease and degree of valvular incompetence has already been established.[1] This study analyses the distribution of levels of venous reflux on duplex imaging and its correlation with objective clinical signs such as varicose veins, venous ulceration and skin pigmentation (e.g. lipodermatosclerosis).[2] Ruckley et al pointed out that a worsening grade of chronic venous insufficiency (CVI) was associated with higher prevalence of reflux in all deep and superficial segments of veins but there was no reflux, either superficial or deep in 36.5 % of their patients with CVI[2]

In our series we noted that venous disease was more common in females than males (80.3% v 19.7%) [2,7] and a significant proportion of patients had bilateral venous disease (48.9%). There was also a predominance in the incidence of active ulcers (70.5%) and skin pigmentation (74.4%) in women [6,7,] and, in a comparative series, women were more likely to have telangiectasia and men had a higher incidence of trunk varices, trophic changes and venous reflux.[3,4, 8] Obermayer et al also noted that twenty (20%) of their ulcer patients showed no clinically visible varicose veins.

In this series, the commonest level of incompetence encountered was at the sapheno-femoral junction (SFJ) which accounted for 75% of limbs with reflux.[9,10] This is in keeping with the clinical finding that superficial reflux is the main finding in patients with clinical CEAP C-2 disease.[11]When limbs with uncomplicated varicose veins, lipodermatosclerosis and venous ulceration were compared, superficial reflux alone was the most common finding. Deep venous reflux has been typically seen in cases of non-healing ulcers, particularly when the source is the popliteal vein.[10,11] The superficial reflux was found to be significantly less in patients with LDS and venous ulceration.[12]

Although several studies have shown that the larger proportion of limbs with complications of venous disease have little or no deep reflux [12,13,14] there is really a steady increase in deep reflux as clinical stage gets worse,[15] and superficial and deep venous reflux can coexist in the veins of patients with venous ulcers with sometimes as much as 87% of ulcers having some degree of reflux in the local area around ulcer.[16] There is still quite a fair amount of controversy in the role of reflux in venous ulceration and published studies vary considerably. However, is now very clear that venous ulceration can occur due to reflux in the superficial, deep or perforating systems of varicose veins.[17,18]

In comparison with international data can our differences be accounted for by racial or socio-economic factors peculiar to a developing country? Myers et al in studying 776 limbs with primary uncomplicated varicose veins and 166 with “complicated limbs” noted Superficial Venous Reflux (SVR) in primary veins, limbs with

lipodermatosclerosis and limbs with past ulcers in 55%, 39% and 38% of patients and deep reflux in 2%, 7% and 8% respectively.[12] Our results show 54% SVR (superficial venous reflux) in primary veins, deep reflux in 8% and mixed in 4%. In a similar study Hjerppe observed that of those patients with ulcers, isolated superficial reflux was found in 64% of healers and 36% non-healers whilst isolated deep reflux was noted in 14% healers and 41% non-healers and whilst other investigators found popliteal reflux was much higher in those with delayed and non-healing ulcers[10,11] and the great majority of patients had recurrence with 66% having episodes of ulceration for greater than five years.

In a smaller series of 48 patients with venous ulcers, Mastroroberto[13] found multi- system incompetence in his patients. The results showed 88.3 % of patients had incompetence, 21.6% had superficial and perforator reflux, 21.6% had superficial and deep reflux, 15.7% had perforator and deep reflux whilst 29.4% had all three. However, regarding the perforators in the ulcer bed, in 35.3% of ulcers there was no evidence on Doppler of venous abnormality.[2,14]

Shami[14] found in 59 consecutive patients (118 limbs) with venous ulceration, 53% patients had superficial reflux, 32% superficial and deep and 15% isolated deep reflux[14].In just over half of patients with venous ulcers, there was only superficial venous reflux. Welch[15] evaluated 320 patients (500 legs) and found that the class with superficial varicosities, Class 1(in the clinical grade according to the Society for Vascular Surgery/ International Society for Cardiovascular Surgery, North America reporting standards in

venous disease [16]) had the highest incidence of isolated superficial reflux (56%), deep in only 5% and combined superficial and deep in 14% of patients .in a similar study involving six hundred patients, the median duration for ulceration was nine (9) months and 20% had not healed in 2 years.[19] and Labropoulos showed[20] that variable combined patterns were noted in over two thirds of patients with ulceration with 64% being multisystem deep venous reflux in 6% patients, perforators in 3% and isolated superficial incompetence in 23% and in combination with perforator system alone 21%.

Therefore our series compares favourably numerically (284 patients/423 limbs) with the two larger series Welch (320 patients/550limbs), Myers (776 uncomplicated/166 complicated limbs) with all three having similar figures for superficial venous reflux in uncomplicated disease (Welch 54%, Myers 55% ours 54%) . Lipodermatosclerosis (LDS) mentioned specifically as part of class 2 CVI was also noted by Myers [12] (39% superficial and 7% deep) compared with our study (51% superficial, 28%deep).

Considering venous ulcers (class 3 CVI) Welch's series showed a predominance of superficial reflux (in past ulcers: 38% superficial, 8% deep), Shami's figures were higher but predominantly that of superficial reflux (53% superficial reflux,32% superficial/ deep,15% deep) but ours showed a reversal of this trend with deep reflux being the predominant finding (57% deep,32% superficial,11% superficial/deep) and Mastroroberto varied even more with multisystem incompetence being evident (29% superficial/perforator/deep, 22% superficial /perforator and 22% superficial/deep).

Although chronic venous ulcers were more common in women, no difference was seen in age- related prevalence and in 36% of patients there was at least one other etiologic factor leading to the ulcer formation (96% had a history of a DVT or a condition predisposing patient to a DVT). [20]

Whether socio-economic factors play a part in these variations is still to be decided but ethnic differences may be a factor. Ruckley pointed out that the Edinburgh vein study had a 98.9% white cohort "reflecting the ethnic mix in the city".[2] Our patient population is a mixed one of Asian East Indians, Afro-Caribbean's, Oriental Asians of Caribbean heritage, a small Caucasian population of European descent as well as a Middle-East population derived primarily of Lebanese and Syrians, all of whom have significantly varying physical attributes and different lifestyles, which may have contributed to the observed difference in reflux patterns. These will have to be examined and analysed in future studies.

Conclusion:

There is a significant and widespread population who suffer from venous disease or its complications and the associated morbidity, chronicity and the cost of management worldwide. [21] The progression to chronic venous insufficiency with changes such as lipodermatosclerosis and venous ulceration have required that researchers pay attention to and try to quantify the presence of venous reflux, its degree of severity and the anatomical locations of these areas.

Duplex scanning is the tool used to answer these questions and to clarify the findings with those of the clinical presentation of the patient. It can be looked upon as an examiner trying the solve the "puzzle" of the patient's clinical picture and how this relates to the presence, the sites and degrees of venous reflux.[22]

Superficial venous reflux is now thought to be better evaluated by a double rather than a single ultrasound probe, [23] comparing venous reflux duration and cessation above and below knee simultaneously. Deep Venous Reflux (DVR) is an often poorly defined item. Clinically we are really unsure of the extent it must be quantitatively to be of clinical significance, and this is aggravated by the concomitant presence of superficial venous reflux at the anatomical sites evaluated. [24]

Superficial venous and reflux does not necessarily have to originate from a saphenous junction but can arise from the trunk vessels such as the great saphenous vein or the small saphenous vein. Quereshi found that in legs with a competent SFJ, there was below- knee great saphenous vein reflux (53%) and when the SFJ was incompetent there was combined above and below-knee great saphenous vein reflux (72%). [25]

Progression of this venous disease is noted to increase when there is reflux in the superficial venous system and is aggravated when there was associated deep reflux.[26] In the landmark Edinburgh Vein Study [2] 50% of patients deteriorated during the 13 years until review and 33% with varicose veins then showed signs of skin changes with increased risks of ulceration.[2, 26]

Our study found that SVR (Superficial venous reflux) is really the main component of uncomplicated varicose veins as well as limbs showing severe skin changes such as lipodermatosclerosis. Venous ulcers were more likely to be due to deep venous reflux, although our study found a significant portion to be associated with superficial reflux (32%), mainly at the sapheno-femoral junction (SFJ).

We already know that venous ulcers can be seen in patients with Valvular incompetence at the superficial, deep or perforator systems, a combination of any two and also in all three. [14, 20, 21] The figures compare with other large studies for uncomplicated venous disease but we noted a higher rate of deep venous reflux in patients with venous ulcers in our series than similar studies, probably reflecting an ethnic or socio-economic variation.

Disclosure: The authors have nothing to disclose

Conflict of interest: There is no conflict of interest amongst all the authors.

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