

**AFRICAN JOURNAL OF
MEDICINE
and medical sciences**

VOLUME 29, NUMBER 1, MARCH 2000



**EDITOR:
B. O. OSOTIMEHIN**

**ASSISTANT EDITOR:
A. O. UWAIFO**

ISSN 1116 — 4077

The selective use of duplex scanning in the pre-operative assessment of primary and uncomplicated varicose veins identifies patients with 'early' morphological disease

E .O. Olapade-Olaopa, B. U. Dikko, D. M. Foy and S.G. Darke.
Department of Surgery, The Royal Bournemouth Hospital, Castle Lane East, Bournemouth, United Kingdom

Summary

The standard management of primary lower limb varicosities (stripping of the long saphenous vein (LSV) with avulsion of the varicosities) is based on the assumption that the disease originates from primary valvular insufficiency and incompetent perforating veins. It has recently been suggested that the LSV may be spared in patients with superficial varicosities without incompetence of this vein, i.e. early disease. However, pre-operative identification of suitable patients for conservative surgery has proved difficult. In this study, we employed selective duplex scanning in cases with primary varicosity in whom sapheno-femoral and sapheno-popliteal incompetence had been excluded both clinically and with the hand-held dopler (52 limbs [10% of new referrals]). We found that the varicosities in these limbs were of 3 types: (a) those arising independent of superficial vein incompetence (Type 1); (b) those associated with segmental LSV incompetence (Type 2); (c) those in whom incompetence of the sapheno-femoral junction and LSV was missed (Type 3). We therefore suggest that long saphenous varicosity may progress from Type 1 through to Type 3 with each type representing an increase in severity of the disease. We suggest that selective use of duplex scanning will assist in identifying those patients with early stages of the disease who can then be treated effectively with LSV-sparing surgery.

Keywords: *Varicose veins, duplex ultrasound scan, colour doppler, continuous wavedoppler, saphenous veins, venous reflux.*

Résumé

Le traitement standard de la varicosite primaire ueiucbres inferieures (LSV) est are sur la papposition selon laquelle la inaladie a pour on'gine l'ensufisance valvulouire poimoure et la perforation des veines. Il a recemeut 'ete' suggere' que la LSV povrrait etre evite chez les patients ayant des vircosites superficielles sans inselfficence uvcoupe tence de les vienes i.e au debut de la malaclie. Cependent, identification pre-operative des bons patients pour la chirurgie conservative a ele prove difficile.

Dans cette etude, nous avons employe la methode selective de scouner appele scanning duplex dou les las de varvcosile provneiuers chez quir la perforation des veines sephano-femural et sephano-poplietal avouirent ele exclus climiquement et a l'examination au toucher (52 members

C10% des nouveaux cas referres) Nous avons coustale qure has varilosities chex tes vincludures etaient de 3types:a) leux survant indepen dement de la perjonation ou in suffbonic des veives superficielles (typei); b) leux assoues a la perforation de la LSV segmentahe (type) et leux chezqui la perforation de la fonction due sephano-femoral et la LSV unauquait (types3). Nous avons par consequent suggerequire la varicosile du long sephaneux pouriait progresse-du tejepei au types 3 avec cheque type represeutant une augmentation de la sreve vete de la maladie. Nons suggევont que l'utili sation de la methode selective de scanning du duplex pour ait assister dans eidentification des pateients aufount un stage prminaire de la mahadire qui pent etre etre traile effectienet avec la LSV evitant la chirurgie

Introduction

The conventional teaching basing the pathogenesis of varicose veins on primary valvular insufficiency and incompetent perforating veins has been challenged recently. Based on laboratory studies on the venular wall and pre-operative observations, some authors have suggested that the disease process may begin in the venous tributaries with the main saphenous trunk being affected in the later stages [1, 2]. This idea supports the proposal that the long saphenous vein (LSV) could be spared in some patients during operative treatment of the disease [3, 4].

The failure of this new concept in effecting radical changes in the established surgical management of varicose veins centres around the inability of surgeons to identify suitable patients pre-operatively. Although the use of the hand held continuous wave doppler (CWD) in the evaluation of patients presenting with primary varicose disease is well documented [5, 6], the duplex scanner has the advantage of providing detailed pre-operative information about the anatomy and haemodynamics of varicose veins [7-10]. However, the use of duplex ultrasound in all cases would carry significant resource implications and may thus be impractical and/or unjustified. In this study therefore, we have employed duplex scanning selectively in those patients with primary varicose veins of uncertain origin after CWD examination.

Patients and methods

Over a 12month period, a consecutive series of new patients referred with primary long saphenous varicosity was reviewed. As this was a secondary referral practice they are assumed to represent a relatively unbiased sample of an average community. All patients had a standard clinical and CWD examination carried out by a single examiner (SGD).

Corresponding: Mr. E. Oluwabunmi Olapade-Olaopa, Section of Urology, Department of Surgery, University of Michigan Medical Center, 1500 E. Medical Center Drive, Ann Arbor, MI 48109 - 0330, USA. Tel: +1 734 6150563. Fax: +1 734 936912 E-mail: eolaopa@umich.edu

Patients with complicated disease (i.e. ulceration or recurrent varicosities) were excluded from the study. CWD examination (Huntleigh dopplex 500 Probe 8 MHz) of the affected limbs was done as detailed in our earlier reports [5, 11] to detect sapheno-femoral, popliteal, short saphenous and perforator incompetence. Briefly, the probe was placed on an appropriate varicosity or anatomic point (sapheno-femoral and sapheno-popliteal junctions [SFJ and SPJ], and long saphenous and anterior thigh veins), and the detection of a 'reflux' sonic signal during a squeeze/release, cough or tapping test (as appropriate) was taken as confirmation of venous incompetence. Only those patients in whom SFI, SPI and varicosity of either the anterior thigh vein or short saphenous system were excluded by CWD examination were recruited into the study and referred to the Medical Physics Department for duplex scanning.

Duplex ultrasound imaging of the study patients was done using an Acuson 128/10 colour duplex scanner with a 7MHz linear array probe. All affected limbs were examined by a single examiner (DMF) using a technique of scanning that has been described in detail elsewhere [12]. Briefly, the common femoral (CFV), superficial femoral (SFV), profunda femoris (PFV) and the long and short saphenous (LSV and SSV) veins were identified with the duplex scanner. The LSV and SSV, their main branches and communications with the deep system (the SFJ and SPJ) and the superficial varicosities were then examined in greater detail with longitudinal and transverse scans. Further examination was done in two steps. First, the saphenous veins, the SFJ and SPJ were examined and tested for reflux by asking the patient to perform a valsalva manoeuvre and by manual compression of the calf. Venous reflux produced by either technique was detected by the pulsed doppler, and backflow of a moderate or severe grade as previously described [11] was classified as significant incompetence. Next, the communication between the superficial varicosities and the main venous systems (superficial and deep) was identified and the presence of retrograde flow confirmed. The medial thigh perforators were also interrogated, and the dynamics of blood flow through them determined.

Classification of primary lower limb varicosities

On the basis of the findings of the duplex imaging, the varicosities were classified into 3 types using a modification of the classification described by Johnson and Rutherford [13].

- Type 1 - varicosities arising independent of either saphenous systems (i.e. normal LSV and SSV, and their main branches).
- Type 2 - varicosities arising from segmental reflux in the LSV (distal to a competent SFJ).
- Type 3 - varicosities in connection with SFI or SPI missed on examination with the CWD

Results

A total of four hundred and fifty (450) patients were seen during the 12month period with primary varicose veins. SFI and SPI were excluded with the hand-held doppler ultrasound in 47 patients (10.4%), of which 8 had bilateral disease. There were 31 women and 16 men (M:F ratio = 2:1),

and the mean age was 48 years (range 26 – 70 years). A total of 55 limbs were scrutinised. There was incomplete information for review on 3 limbs and these were excluded from the study. The remaining 52 limbs were divided into the 3 groups described above (Table 1).

Table 1: Distribution of limbs with superficial varicosities but no SFI

Type	No. of limbs (% total)
1	17 (32.6)
2	14 (26.9)
3	21 (40.4)
Total	52 (100)

Type 1 varicosities

Seventeen of the 52 limbs examined (33%) had superficial varicosities in the presence normal LSV and SSV (and their main branches). In 12 of these limbs the varicosities were traced to missed pelvic derived thigh veins (Fig. 1a), whilst in 5 limbs direct connections with the deep venous system (the SFV in 3, and the PV in 2) were found (Fig. 1b). In this latter set of limbs, the superficial varicosities were on the lateral aspect of the thigh only. Occult anterior thigh vein varicosity (a cause of antero-lateral thigh varicosities) was excluded in the affected limbs with the duplex scanner.

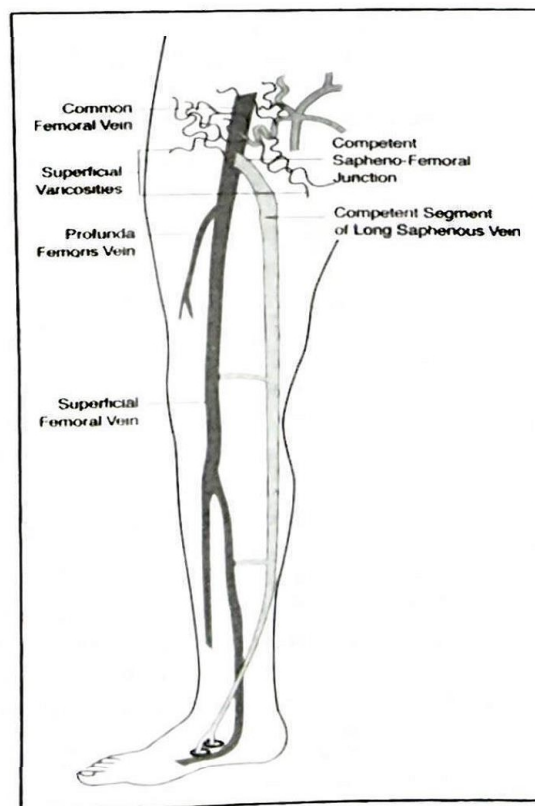


Fig. 1a: Schematic representation of type 1 (no LSV incompetence) superficial varicosities communicating with groin veins

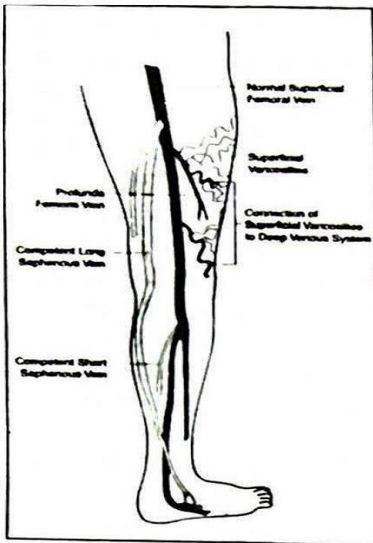


Fig. 1b: Schematic representation of Type 1 (no LSV incompetence) superficial varicosities arising directly from the deep venous system.

Type 2 varicosities

Segmental LSV incompetent was demonstrated in 14 (27%) of the limbs scrutinised, and in all these cases the incompetence was distal to the SFJ. In 6 of the limbs, we were able to establish the presence of reflux in dilated perforators communicating with the incompetent part of the LSV (Fig. 2a). However, bi-directional blood flow was also detectable in some 'normal' perforators draining into varicosed LSVs (Fig 2b). Three legs had a bifid LSV distal to the SFJ with only one of the two branches being partially or wholly incompetent.

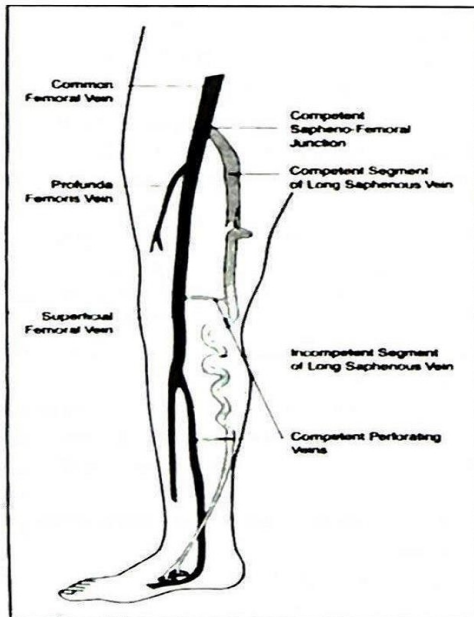


Fig. 2a: Schematic representation of Type 2 (segmental LSV incompetence) superficial varicosities with associated perforator incompetence.

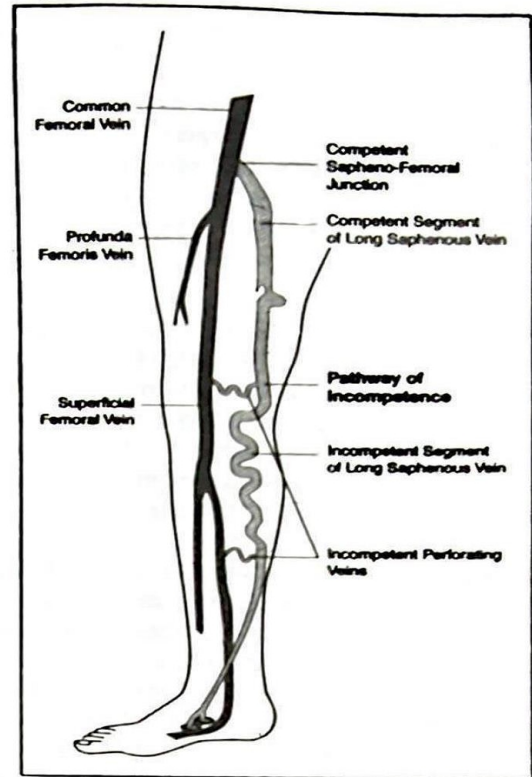


Fig. 2b: Schematic representation of Type 2 (segmental LSV incompetence) superficial varicosities in the presence of 'normal' perforator veins.

Type 3 varicosities

Pathologically significant SFI was detected in 21 of the limbs scanned (40%), with the LSV being incompetent throughout its length (Fig. 3).

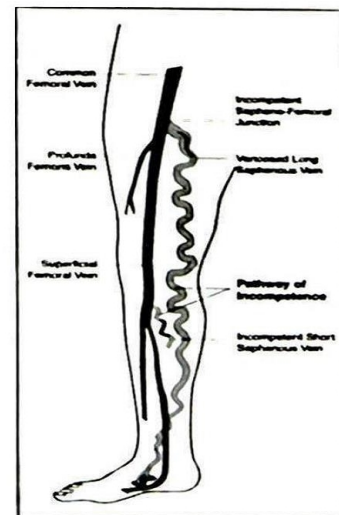


Fig. 3: Schematic representation of Type 3 ('classical' LSV incompetence) superficial varicosities arising from sapheno-femoral valvular incompetence/reflux with dilatation and tortuosity of the LSV in its entire length.

Discussion

The natural history of lower limb varicosity is not yet clearly defined and most surgeons are still offering treatment based on the traditional perception of its pathogenesis (from SFI). However, a number of surgeons have pleaded for the conservation of the LSV during surgery for varicosity, citing its usefulness as an autologous graft in various by pass operations and a reduction in potential operative morbidity (e.g., haemorrhage and nerve injury) [4, 14]. However there are conflicting reports on the long-term results from studies comparing standard (LSV-stripping) and conservative procedures (LSV-sparing with perforator ligation and avulsion of local varicosities) [3, 4, 8, 14, 15].

We concentrated on studying the morphology of lower limb veins in patients with presumed early varicosity in an attempt to improve the understanding of this stage of the disease and thus the ability to identify those patients who would be most suitable for LSV sparing surgery. For the purposes of this study, we defined limbs with early disease as those with superficial varicose veins in which SFI had been excluded, as its presence was taken to signify relatively advanced disease. Duplex ultrasonography is the most current method of investigating lower limb vessels, and has the advantage of being accurate and non-invasive. It is easily repeatable and is becoming readily available in most vascular units in the developed world. The decision to scan only those patients that had been screened by the simpler (and cheaper) CWD examination enabled us to combine the advantages of both methods with the aim of improving the standard of assessment of our patients.

The accurate identification of limbs with Type 1 varicosities was significant as these patients would derive little benefit from stripping of the saphenous veins. Instead, avulsion of the superficial varicosities (with ligation of the associated groin veins where necessary) was our preferred treatment. Of interest was our finding of superficial varicosities arising directly from normal deep veins, and the consistent location of these varices on the lateral aspect of the thighs. This was an unusual type of varicosities as an earlier study had shown that deep veins involved in lower limb varicosity had demonstrable incompetence, and that the vast majority of these legs (96%) had associated incompetence of the superficial (saphenous) systems [16]. We have previously reported on this finding of Type 1 varicosities in an earlier publication [17]. As such, we would suggest that patients with an unusual distribution of varicosities in the presence of competent saphenous systems should be referred for duplex scanning.

Limbs with Type 2 varicosities segmental LSV incompetence) were a heterogeneous group. In all these cases the venular dilatation was distal to the SFJ, thus confirming that the sapheno-femoral valve was not involved at this stage. We, and others, have previously presented evidence of segmental LSV reflux (without SFI) [11, 17]. This study therefore provides further support of the assertion that saphenous incompetence may arise from various points along the vein, and progress in an ascending and/or descending manner. Thus, it is possible that this group of varicosities represent a progression on the Type 1 disease. Varicosity affecting only one branch of a multi-channelled LSV, and the management difficulties posed by the same, has previously been reported

[cited in ref. 10]. Our finding in some limbs of bifid LSVs distal to the SFJ, with partial or total incompetence of only one of the branches, is in keeping with these earlier reports. Notably, Type 2 varicosities were inconsistently associated with dilated perforating veins and 'reflux' signals were also detected in 'normal' perforators in these limbs. Bi-directional were also detected by Mc-Mullin *et al* [18], in 'normal' communicating veins in their study. Interestingly, Quigley *et al* [19] had cited perforator incompetence as the cause of primary varicosities in 28% of their patients. However in this (and our earlier [11]) study, we could not confirm these veins as the primary cause of superficial varicosities. As such we are unable to conclude that incompetent perforators are always responsible for partial dilation of the LSV, but clearly they play a part. We conclude that patients with Type 2 varicosities will benefit from stripping of the LSV only if the precise anatomy is identified pre-operatively (by imaging) so that the appropriate vein (or segment thereof) is stripped and the perforators ligated where necessary.

The demonstration of significant SFI with wholly incompetent LSV (Type 3 disease) in 40% of limbs included in this study was also a surprising finding as it represents pathology missed by the hand-held Doppler ultrasound. This represents a CWD specificity of 60% in this group of patients. Along with the report of 10.2% false positive results in Tong *et al.*'s study [8], this is an important finding considering the widely acclaimed accuracy of this technique in evaluating sapheno-femoral competence. Considering the fact that the hand-held Doppler has remained the commonest method of assessing limbs with primary varicosities, this important observation may explain the relatively high incidence of recurrent varicosity in patients treated with sclerosant injections on the grounds that SFI had been excluded by the ultrasound (unpublished data). Our finding indicate that occult SFI should be excluded in these patients with a duplex scan.

Conclusion

This study has identified a varied morphology in patients with primary long saphenous varicosities in whom the sapheno-femoral junction is truly competent. The various anatomical types described could influence the choice of the surgical procedure prescribed as treatment. We suggest that in its natural history, long saphenous varicosity may progress from Type 1 through to Type 3 with each type representing an increase in severity of the disease. However, since the majority (90%) of new patients with varicose veins referred to our unit had Type 3 disease at presentation, we accept that saphenous incompetence may arise *de novo* in most cases of the disease. We propose that selective duplex scanning of patients initially screened with the hand-held doppler will assist in identifying those patients with early stages of the disease who can then be treated effectively with procedures that preserve the LSV.

References

1. Rose S and Ahmed A. Some thoughts on the aetiology of varicose veins. *Journal Cardiovascular Surgery*, 1986; 27: 534-543.

- Haimovici H. Role of precapillary arteriovenous shunting in the pathogenesis of varicose veins and its therapeutic implications. *Surgery*, 1987; 101: 515-522.
- Hammarsten J and Pedersen P. Long saphenous vein saving surgery for varicose veins. A long follow up. *European Journal Vascular Surgery*, 1990; 4: 361-364.
- Fligelstone L, Carolan G, Pugh N, Shandall A and Lane I. An assessment of the long saphenous vein for potential use as a vascular conduit after varicose vein surgery. *Journal Vascular of Surgery*, 1993; 18: 836-840.
- Mitchell D and Darke D. The assessment of primary varicose veins by doppler ultrasound the role of sapheno-popliteal incompetence and the short saphenous systems in calf varicosities. *European Journal Vascular Surgery*, 1987; 1: 113-115.
- Campbell WB, Niblett PG, Ridler BM, Peters AS, and Thompson JE. Hand-held Doppler as a screening test in primary varicose veins. 1997; 84: 1541-1543.
- Payne SP, London NJ, Newland, CJ, Barrie WW. and Bell PR. Clinical significance of venous reflux detected by duplex scanning. *British Journal of Surgery*, 1994; 81: 39-41.
- Tong V and Royle J. Recurrent varicose veins following high ligation of saphenous vein: a duplex ultrasound study. *Cardiovascular Surgery*, 1995; 3: 485-487.
- Wills V, Moylan D, and Chambers J. The use of routine duplex scanning in the assessment of varicose veins. *Australian and New Zealand Journal of Surgery*, 1998; 68: 41-44.
- Georgiev M. The preoperative duplex examination. *Dermatological Surgery*, 1998; 433-440.
- Darke SG, Vetrivel S, Foy DM, Smith S and Baker SA. Comparison of duplex scanning and continuous wave doppler in the assessment of primary and uncomplicated varicose veins. *European Journal of Vascular and Endovascular Surgery*, 1997; 14: 457-461.
12. Darke S and Foy D. Pre-operative investigation for un-complicated varicose veins., in *Vascular Surgery*, R. Greenhagh, Editor. WB Saunders: London. 1995; 401-414.
13. Johnson G and Rutherford R. eds. *Varicose veins: patient selection and treatment*. Vascular Surgery, Editor. R.Rutherford. Vol. 2. 1995, WB Saunders Company: Philadelphia. 1995; 1825-1828.
14. Koyano K and Sakaguchi S. Selective stripping operation based on Doppler ultrasonic findings for primary varicose veins of the lower extremities. *Surgery*, 1988; 103: 615-619.
15. Sarin S, Scurr J, and Coleridge-Smith P. Stripping of the long saphenous vein in the treatment of primary varicose veins. *British Journal of Surgery*, 1994; 81: 1455-1458.
16. Katsamouris A, Kardoulas D and Gourtsoyiannis N. The nature of lower extremity venous insufficiency in patients with primary varicose veins. *European Journal of Vascular Surgery*, 1994; 8: 464-471.
17. Olapade-Olaopa EO, Foy DM, Dikko B and Darke SG. Primary lower limb varicosities arising directly from normal deep venous systems: a series report. *Ann. Vasc. Surg.* 2000; 14: 166-169.
18. Mc-Mullin G, Coleridge-Smith P and Scurr J. Which way does blood flow in the perforating veins of the leg? *Phlebology*, 1991; 6: 127-132.
19. Quigley FG, Raptis S, Cashman M, and Faris IB. Duplex ultrasound mapping of sites of deep to superficial incompetence in primary varicose veins. *Australian & New Zealand Journal of Surgery*, 1992; 62: 276-278.