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Duplex-derived Evidence of Reflux After Varicose Vein Surgery: Neoreflux or Neovascularisation?

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Background: *recurrent varicose veins remain a problem in surgical practice despite improvements to the preoperative investigation of, and surgery for varicose veins. Neovascularisation accounts for some cases of recurrence within a few years of surgery, but other factors relating to disease progression must also play a part. We investigated whether new venous reflux (neoreflux) could occur in the early postoperative period (within 6 weeks) following successful varicose vein surgery.*
Methods: *eighteen-month prospective observational study in the dedicated vascular surgery unit of a university teaching hospital. Forty-six patients, with primary saphenofemoral junction reflux, awaiting varicose vein surgery were chosen consecutively from the waiting list. All saphenofemoral surgery was performed in a standardised fashion. Assessments were performed prior to, at 6 weeks and at 1 year after surgery. Duplex ultrasound was used to identify and locate sites of reflux.*
Results: *neoreflux was present at the 6-week postoperative scan in nine limbs after varicose vein surgery (19.6%), and resolved in 55.6% of patients within 1 year. Neovascularisation was noted in two limbs at the 1-year scan.*
Conclusion: *new sites of reflux, which may resolve spontaneously, occur in the early postoperative period despite adequate varicose vein surgery. It is our hypothesis that this is a manifestation of the effect of altered venous haemodynamics in a system of susceptible veins.*

Key Words: Varicose veins; Duplex ultrasound; Neovascularisation.

Introduction

It is estimated that 10–20% of the world's population has varicose veins in the lower extremities. Over 58 000 operations per year are performed for varicose veins in this country.[1] Despite the best intentions of surgeons, recurrence following primary varicose vein surgery is widely reported at between 7 and 77%.[2,3] Reasons for recurrences following varicose vein surgery are variably discussed in the literature. These include insufficient understanding of the venous anatomy or haemodynamics, inadequate preoperative assessment, incorrect or insufficient surgery and development of new locations of superficial-to-deep insufficiency.[4] Blame for recurrence has been previously laid on the junior surgeon,[5,6] but it has also been shown that with appropriate supervision and training satisfactory varicose vein surgery can be performed by the surgical trainee.[7] More recently it has been demonstrated that even after adequate surgery new sites of reflux may appear due to neovascularisation or disease progression,[8] although most cases of neovascularisation take at least 12 months to develop.

It is our hypothesis that new reflux may develop in the early postoperative period despite adequate varicose vein surgery, due to the altered pattern of venous return attributable to that surgery. This may therefore represent a mechanism for the subsequent development of new clinically apparent varicose veins despite initially adequate surgery.

Methods

An 18-month prospective observational study was carried out on 46 patients with primary varicose veins and reflux at the saphenofemoral junction. Patients were chosen consecutively from the waiting list over a 12-week period, in the dedicated vascular unit of a

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university teaching hospital. There were 14 male and 32 female patients, median age 51, range 27–75 years. The median duration of symptoms was 6.5 years (range 1–33 years). Sclerotherapy had previously been performed in two patients (4%), although none within the previous 12 months. A further five (10.8%) patients had previously had varicosities treated by multiple stab avulsions, but none were attending for surgery due to recurrent reflux at a site previously operated on (redo surgery).

Informed consent was obtained from each patient. The protocol of assessment comprised an initial outpatient assessment by a consultant vascular surgeon. Clinical examination was aided by hand-held Doppler ultrasonography (using 4 and 8 MHz probes) for all cases. The exact sites of venous reflux were confirmed preoperatively by duplex ultrasound using either an Acuson 128 machine (Acuson, Mountain View, California, U.S.A.) with a 5 MHz linear probe, or a Bruel-Kjaer machine (B&K Medical, Copenhagen, Denmark) with a 5 MHz curved probe. Examinations were performed by either a vascular consultant radiologist or vascular technologist working to a strictly agreed protocol. Venous reflux was elicited with the patient in the standing position using manual calf or thigh compression. Reflux was defined as reverse flow for greater than 1 s. Patency of the deep venous system was initially assessed by compressibility of the deep veins and with colour Doppler. The superficial venous system was systematically insonated using a combination of colour and pulse wave doppler. Reflux in the femoral and popliteal veins was assessed distal to the SFJ and SPJ, respectively. Any patients with incompetence at the SPJ returned the day before surgery to have the site marked with the aid of Duplex imaging.

All patients received a single dose of 20 mg subcutaneous Clexane (Rhone-Poulenc Rorer, Eastbourne) 1 h before surgery. Operations were performed as a day case by a surgical trainee under the direct supervision of a consultant vascular surgeon. The saphenofemoral junction was ligated in a standardised fashion. This comprised a full dissection of the four quadrants of the junction, with skeletonisation of tributaries. These were divided as distally as possible or at points of their bifurcation connections. The femoral vein was exposed up and down stream and small side branches clip-ligated. The LSV was stripped to either just above or below the knee, with either a PIN stripper (Credenhill, Derbyshire, UK) or Vas stripper (Astra Tech, Gloucestershire, UK). Saphenopopliteal junction ligation was performed with the patient in the prone position, and the incision placed according to the site of the junction as marked preoperatively by duplex. Stab avulsions were performed using a 30° microsurgical knife (Skymed, Marston, UK) and Oesch hooks (Credenhill, Derbyshire, UK).

Table 1. Sites of preoperative reflux demonstrated by duplex ultrasound.

Site of reflux	Total number
Saphenofemoral junction	46
LSV thigh	45
LSV leg*	1
Mid-thigh perforator	7
Thigh-vein incompetence†	2
Saphenopopliteal junction	2
Deep vein	0

LSV = Long saphenous vein.
* Long saphenous vein above and below-knee.
† Tributaries of the LSV.

A Pannelast bandage (Vernon Carus, Preston) was applied at the end of the operation and worn for 1 week. This was replaced by a class I graduated compression stocking (Mediven, Medi U.K. Limited, Hereford, UK) which patients were instructed to wear for a further 5 weeks.

All patients attended for further duplex ultrasound evaluation at 6 weeks and again at 12 months from surgery. Evidence was sought for new sites of reflux or residual reflux at the site of primary surgery. The examiner used the same protocol of examination employed at the preoperative scan and was kept unaware of the previous results.

Results

All patients were demonstrated to have a patent and competent deep venous system, with evidence of superficial venous disease only prior to surgery. The sites of preoperative reflux are shown in Table 1. The majority of patients had primary reflux at the saphenofemoral junction into an incompetent long saphenous vein in the thigh. In a few patients this was associated with a refluxing thigh perforator, other thigh vein or saphenopopliteal junction. All 46 patients underwent saphenofemoral junction ligation, stripping of the long saphenous vein, and multiple stab avulsions. Two of these patients also had saphenopopliteal junction ligation.

Successful follow-up was achieved in each case at 6 weeks and 1 year. Surgery was deemed successful if the primary site of reflux, as demonstrated preoperatively, was abolished on the postoperative duplex ultrasound scan. This was achieved in all 46 operations. The postoperative scan demonstrated that new sites

Table 2. All new sites of reflux demonstrated in nine patients at 6 weeks from surgery by duplex ultrasound.

Site of reflux	Total number
Saphenofemoral junction	0
Long saphenous vein	0
Mid-thigh perforator	1
Thigh-vein incompetence*	3
Saphenopopliteal junction	3
Superficial calf vein	1
Femoral vein	3
Popliteal vein	1

* Tributaries of the LSV.

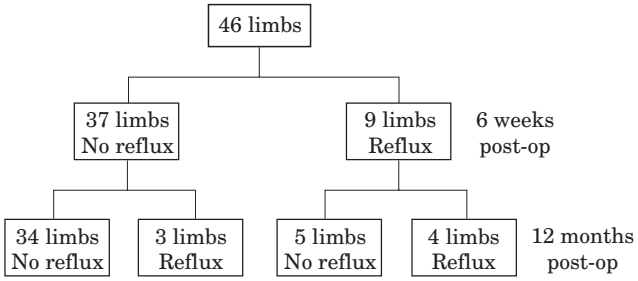

Fig. 1. Duplex ultrasound results demonstrating presence or absence of reflux at 6 weeks and 12 months from surgery. New reflux appeared in nine limbs within 6 weeks from surgery. Five limbs with new reflux demonstrated on the 6-week scan had resolved by 12 months.

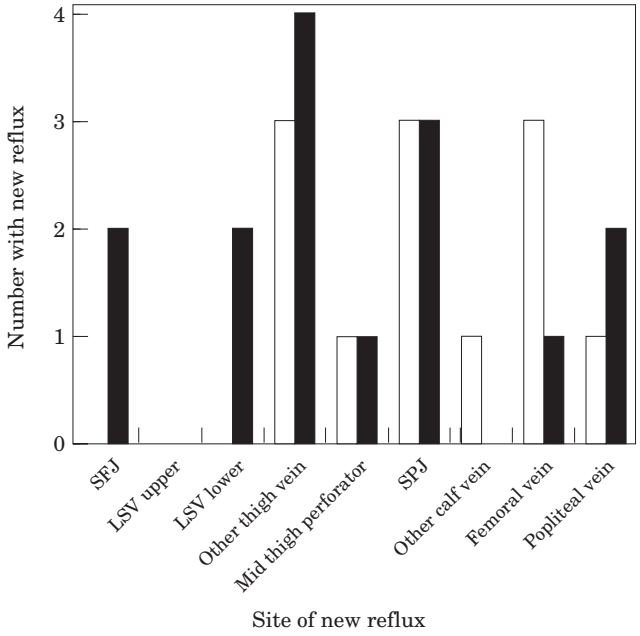

Fig. 2. Sites of new reflux identified by duplex ultrasound at 6 weeks and 1 year. (□) Six weeks postop; (■) 1-year postop. Abbreviations: SFJ, saphenofemoral junction; LSV, long saphenous vein; SPJ, saphenopopliteal junction; MTP, mid-thigh perforator; Fem, femoral; Pop, popliteal.

of reflux appeared in a total of 12 patients (26%) at some time from the operation over the 12-month period of follow-up. In nine patients (19.6%) this reflux appeared within just 6 weeks of surgery (Table 2). When reimaged at 1 year from surgery, the reflux had disappeared in five of these patients, but remained or was associated with additional reflux in the remaining four (Fig. 1). Neovascularisation at the saphenofemoral junction (defined as serpentine tributaries arising from the ligated saphenofemoral junction) accounted for just one new case of reflux identified at the 1-year scan, in these four patients.

Of the 37 patients who had no evidence of incompetent veins at the 6-week postoperative scan, three were found to have developed new reflux when reimaged at 1 year. This comprised reflux at the SPJ in one patient, an incompetent medial thigh vein in another, and neovascularisation at the SFJ with incompetence of an anterior thigh vein in the third patient. The sites of reflux identified at either the 6-week or 1-year postoperative scans are illustrated in Fig. 2.

Discussion

The cause of primary varicose veins is generally represented by two theories. The "incompetent valve theory" supposes that the fundamental cause is a gradual and successive development of incompetent valves in the main saphenous vein or communicating branches. The "weak wall theory" supposes that the vein wall of some individuals is or becomes inherently weaker, (perhaps due to biochemical differences) allowing the development of venous dilatation,[9,10] and incompetence of the adjacent venous valves. It is possible that both patterns occur in the clinical situation.

Work by Bjordal has previously shown that in patients with varicose veins considerable reverse flow descends the incompetent long saphenous vein and re-enters the deep veins via the calf-perforating veins.[11] This flow is abolished by long saphenous vein stripping and should considerably reduce reflux, although the flow must be channelled in an anterograde direction through the remaining superficial and deep veins of the leg. Following surgery, the sudden haemodynamic alteration to venous return in the superficial and deep veins could "overload" some veins that have been competent but have an inherent weakness or uncover others that were partially incompetent but masked by the main source of reflux.[12] New reflux, or perhaps better described as neoreflux, may consequently appear in these veins early in the postoperative period. This was seen in nine patients (19.6%) in our series at the 6-week duplex scan, despite complete abolition of sites of reflux identified preoperatively. Adaptation of the vein wall or further

alteration of the pattern of venous return may then allow some veins to regain competence, as occurred in five patients in our series. Late incompetence appearing after 1 year from surgery is more likely to be associated with neovascularisation, or natural disease progression, but needs to be differentiated from neoreflux that may have developed as a result of early haemodynamic changes.

Methodological error may have accounted for some cases of neoreflux seen in some patients in this study. But the identification of major sites of reflux by duplex ultrasound is unlikely to be affected by a large inter-observer error, provided the examination follows a strict protocol and is performed by an experienced ultrasonographer. The two ultasound machines used in our study had equal sensitivity for detecting reflux at the sites chosen for investigation. We routinely employ a definition of reflux as a duration of over 1 s, which is longer than that used by some centres. This would help reduce the false positive reporting of reflux, attributable to inadvertent inclusion of normal veins[13–15] or as an effect of inter-observer error.

The clinical significance of duplex-derived evidence of incompetent veins within 6 weeks from accurate varicose vein surgery remains to be seen. It may be that compression stockings should be worn for a longer time in the postoperative period to allow adaptation of the remaining veins to a new haemodynamic pattern.

In conclusion, we have demonstrated that even following accurate varicose vein surgery neoreflux may appear in 20% of limbs within 6 weeks, although this appears to be a temporary phenomenon in up to half of cases. In contrast, neovascularisation becomes manifest at a later stage in the postoperative period.

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References

1 Department of Health and Social Security. *Hospital Episode Statistics*. London: DHSS, 1988.
2 Rivlin S. The surgical cure of primary varicose veins. *Br J Surg* 1975; **62**: 913–917.
3 Royle JP. Recurrent varicose veins. *World J Surg* 1986; **10**: 944–953.
4 De Maeseneer MG, Van Schil PE, Philippe MM, Vanmaele RG, Eyskens EJ. Is recurrence of varicose veins after surgery unavoidable? *Acta Chirurgica Belgica* 1995; **95**: 21–26.
5 Lees T, Singh S, Beard J, Spencer P, Rigby C. Prospective audit of surgery for varicose veins. *Br J Surg* 1997; **84**: 44–46.
6 Negus D. Recurrent varicose veins: a national problem. *Br J Surg* 1993; **80**: 823–824.
7 Turton EPL, McKenzie S, Weston M, Berridge DC, Scott DJA. Optimizing a varicose vein service to reduce recurrence. *Ann R Coll Surg Engl* 1997; **79**: 451–454.
8 Jones L, Braithwaite BD, Selwyn D, Cooke S, Earnshaw JJ. Neovascularisation is the principal cause of varicose vein recurrence: results of a randomised trial of stripping the long saphenous vein. *Eur J Vasc Endovasc Surg* 1996; **12**: 442–445.
9 Rose SS, Ahmed A. Some thoughts on the aetiology of varicose veins. *Cardiovasc Surg* 1986; **27**: 534–543.
10 Waksman Y, Mashiah A, Hod I, Rose SS, Friedman A. Collagen subtype pattern in normal and varicose saphenous veins in humans. *Israel J Med Sci* 1997; **33**: 81–86.
11 Bjordal RI. Circulation patterns in incompetent perforating veins in the calf and in the saphenous system in primary varicose veins. *Acta Chir Scand* 1972; **138**: 251–261.
12 Tibbs DJ. Superficial vein incompetence: further considerations. In: *Varicose Veins and Related Disorders*. Oxford: Butterworth-Heinemann, 1992; 86–126.
13 Lagattolla NR, Donald A, Lockhart S, Burnand KG. Retrograde flow in the deep veins of subjects with normal venous functions. *Br J Surg* 1997; **84**: 36–39.
14 Lagattolla NR, Burnand KG. Duplex ultrasonography for assessment of venous valvular function of the lower limb. *Br J Surg* 1995; **82**: 855–856.
15 Cambell WB, Niblett PG, Ridler BMF, Peters AS, Thompson JF. Hand-held Doppler for screening primary varicose veins. *Br J Surg* 1997; **84**: 1541–1543.

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