Original article

Great saphenous varicose vein surgery without sapheno-femoral junction disconnection

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Background: **The aim of this case–control study was to determine whether preoperative duplex imaging could predict the outcome of varicose vein surgery without saphenofemoral junction (SFJ) disconnection. The duplex protocol included a reflux elimination test (RET) and assessment of the competence of the terminal valve of the femoral vein.**

Methods: **One hundred patients with chronic venous disease who had a positive RET result and an incompetent terminal valve were compared with 100 patients matched for age, sex, clinical class (Clinical Etiologic Anatomic Pathophysiologic (CEAP) class C2–C6) and disease duration, but who had a positive RET result and a competent terminal valve. All patients underwent ligation and proximal avulsion of the incompetent tributaries from the great saphenous vein trunk without SFJ disconnection. Clinical and duplex follow-up lasted for 3 years, and included Hobbs' clinical score.**

Results: **Of legs with a competent terminal valve, 100 per cent were rated as cured (Hobbs' class A or B) and 14·0 per cent developed recurrent varices. Patients with an incompetent terminal valve had significantly worse results: 29·0 per cent had Hobbs' class A or B and 82·0 per cent developed recurrence ($P < 0·001$).**

Conclusion: **Preoperative duplex assessment of the terminal valve could be used to identify patients suitable for varicose vein surgery without the need for SFJ disconnection.**

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Introduction

From the time of Homans[1], the standard surgical treatment for great saphenous varicose veins has included disconnection of the saphenofemoral junction (SFJ)[2–5]. However, as observed since 1861, first by Langenbeck[6], paradoxically this site is the most frequent site of recurrence after varicose vein surgery[7–13]. An effective treatment for varicose veins that does not include SFJ disconnection could eliminate the 'Achilles' heel' of varicose vein surgery.

The question of whether a procedure can eliminate reflux in the great saphenous vein (GSV) by disconnection of its varicose tributaries can be predicted by a duplex ultrasound reflux elimination test (RET) (*Fig. 1*)[14]. This test is positive if GSV reflux disappears after finger compression over the source of the incompetent collaterals. However, the RET alone does not predict the outcome following the CHIVA (Conservatrice et Hémodynamique de l'Insuffisance Veineuse en Ambulatoire) 2 technique of varicose vein treatment, which avoids disconnection at the SFJ[14–17]. Despite good early results with the CHIVA-2 method, reported rates of recurrent reflux were 15 per cent after 6 months[14] and 92 per cent after 3 years[15], with no obvious way to predict a successful outcome[16–18].

Moreover, the successful early outcomes after endovenous thermal ablation for GSV incompetence suggest that SFJ disconnection may not be necessary, because preservation of the terminal valve was not followed by a high rate of saphenofemoral reflux, as normally occurs in the long term after failed SFJ ligation[19,20]. The terminal valve of the common femoral vein (CFV) is located just above the SFJ and is designed to prevent reflux from the CFV into the superficial venous system[21–25]. Preterminal valves are located more distally in the CFV and should prevent reflux from the superficial inguinal veins[25].

Cappelli and colleagues[26,27] described a method to assess reflux at the terminal valve by placing a duplex ultrasound probe on its femoral side and seeking reflux by both calf squeeze and Valsalva manoeuvre. Lack of reflux after both

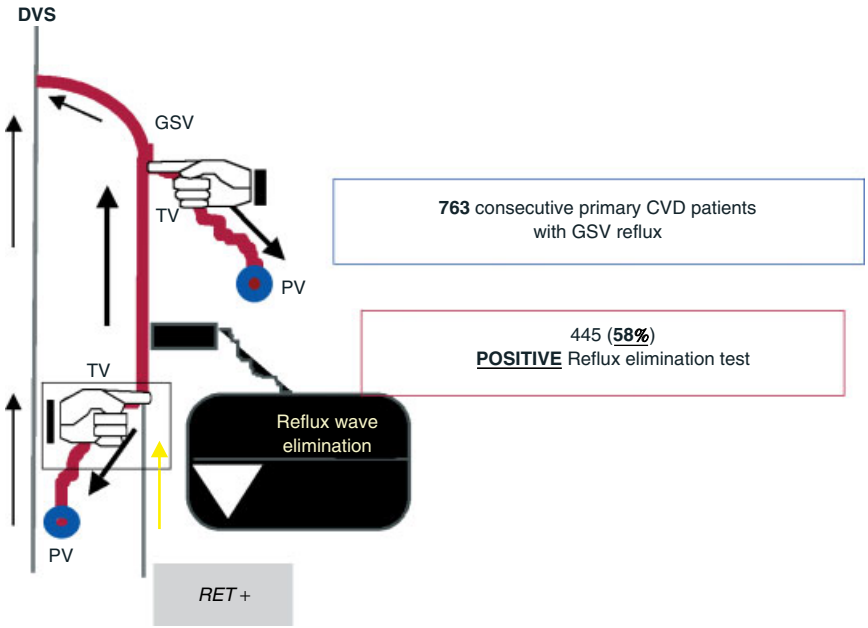

Fig. 1 Reflux elimination test (RET). GSV reflux abolished by finger compression of the incompetent GSV tributary; RET is considered positive. DVS = deep venous system; GSV = great saphenous vein; PV = perforating vein; TV = varicose tributary

manoeuvres was used to define competence of the terminal valve. In Cappelli's series, 55 per cent of legs with GSV reflux had an incompetent terminal valve; in the remaining 45 per cent the terminal valve was considered competent as reflux was recorded in 6 per cent after calf squeeze and 39 per cent after Valsalva manoeuvre, but never both[26,27].

The aim of the present study was to determine whether competence of the terminal valve as assessed by combining the RET with duplex imaging could be used to predict the outcome of GSV surgery performed without SFJ disconnection.

Methods

A total of 763 consecutive patients with primary chronic venous disease (Clinical Etiologic Anatomic Pathologic (CEAP) class C2–C6) underwent clinical examination and duplex imaging (MyLab™ 25, linear array 7·5–10 MHz; Esaote, Genoa, Italy) by an experienced physician familiar with the RET and assessment of terminal valve competence. Duplex examination was performed with the patient standing, and reflux was considered to be present when reversed flow lasted for more than 0·5 s[28–30]. The RET was considered positive whenever finger compression of the incompetent GSV collaterals eliminated GSV reflux[14]. The terminal valve was considered competent on duplex assessment when Valsalva and/or calf squeeze manoeuvres did not produce GSV reflux (*Fig. 1*).

Patients were excluded from the study if they did not have isolated GSV reflux, or if there was any deep vein incompetence. Other exclusion criteria included a defective calf muscular pump or inability to walk; diabetes, autoimmune disease or malignancy; severe renal, hepatic or cardiorespiratory disease; and a history of deep venous thrombosis.

From patients with GSV incompetence fulfilling the above criteria, case–control groups were created, matched for age, sex, disease duration and CEAP clinical class, including 100 patients with a positive RET result and an incompetent terminal valve (group 1) and 100 with a positive RET result and a competent terminal valve (group 2). All patients signed informed consent and agreed to follow-up for 3 years.

Surgical procedure

Some 30 min before the operation, the surgeon marked on the skin the exact point(s) of incompetent tributaries from the GSV trunk using duplex imaging. Next, under local anaesthesia (1 per cent carbocaine, 3 ml in every incision site), patients underwent disconnection of the origin of one or more incompetent tributary veins of the GSV trunk, with no SFJ ligation. Flush ligation was important in order to reproduce the haemodynamic effect of the RET[14]. Dilated tributary veins were avulsed through multiple stab

incisions (5 mm long), sparing the segments above the re-entry perforating veins[14,16].

Surgical wounds were repaired using a single absorbable 4/0 suture or adhesive tape. All procedures were done as a day case, and patients were advised to wear a compression stocking exerting a pressure of 25 mmHg at the ankle for 3 weeks.

Outcome measures

The early results of surgery were evaluated 2 weeks after surgery, to confirm adequate healing and an uncomplicated outcome. After 4 weeks, all patients underwent duplex imaging to ensure reflux had been eliminated in the GSV trunk. Patients had clinical and duplex ultrasound evaluation after 1 and 3 years, both of which were performed blind by an independent physician.

The follow-up assessor assigned a score to each leg according to Hobbs' criteria[31–33]: class A, no visible or palpable varicose veins; class B, a few visible and palpable varicose veins of 5 mm or less in diameter; class C, remaining or newly formed varicose veins with a diameter greater than 5 mm; class D, incompetent main trunks and perforating veins.

In addition, functional and cosmetic results were self-assessed by patients at the time of the final examination in the hospital. A simple scoring system was explained to patients by the investigator. Patients were asked to indicate which of the following applied to them: class A, no inconvenience; class B, slight functional or cosmetic imperfection, but satisfaction with the result; class C, appreciable functional or cosmetic failure – improvement but dissatisfaction with the result; class D, unaltered or increased inconvenience.

Further duplex imaging was undertaken, as above. Recurrent varicose veins were classified into one of three categories: recurrence at the SFJ, recurrence from new incompetent tributaries, or recurrence at the site of tributary ligation, caused by surgical technical failure.

Statistical analysis

Parametric data were reported as mean(s.d.). CEAP scores were expressed as median and interquartile range. Differences in patient populations, demographics and clinical assessment of surgical results between the two groups were compared with the Mann–Whitney *U* test. The χ^2 test for independence was used to assess differences in postoperative Hobbs' categories. The two-tailed Fisher's exact test followed by odds ratios and 95 per cent confidence intervals was used to assess differences in categories of clinical results as well as the risk of recurrence at 3 years. Statistical analysis was performing using InStat™ version 3·0b for Macintosh (GraphPad Software, San Diego, California, USA). $P \leq 0{\cdot}050$ was considered statistically significant.

Results

From the initial cohort of 763 patients with chronic venous disease, 445 (58·3 per cent) had a positive RET result. Subsequent duplex imaging showed that 164 legs (36·9 per cent) had an incompetent terminal valve, and 281 (63·1 per cent) were competent. Matched pairs of patients with either competent or incompetent terminal valves were created and followed up for 3 years; no patient was lost to follow-up.

The two groups were matched for age, sex, CEAP clinical class and disease duration (*Table 1*). Operative methods were similar in both groups; 38 patients in group 1 and 34 in group 2 ($P = 0{\cdot}658$) had multiple phlebectomies. No major complications or readmissions were reported; two wound complications (one infection and one haematoma; 1·0 per cent) were noted.

Clinical assessment of outcome

The clinical results from the surgical procedures in groups 1 and 2, as assessed objectively by the independent assessor and subjectively by the patients, are shown in *Table 2*. Overall, the proportion of patients with an incompetent terminal valve (group 1) with Hobbs' score A or B was 29·0 per cent, and 26·0 per cent assessed themselves as in class A or B. These results were significantly worse ($P < 0{\cdot}001$) than those in patients with an incompetent terminal valve (group 2), 100 per cent of

Table 1 Clinical details of matched patients with great saphenous varicose veins

	Group 1 (incompetent terminal valve) ($n = 100$)	Group 2 (competent terminal valve) ($n = 100$)	P†
Age (years)*	55·0(12·1)	52·7(12·8)	0·100
Sex ratio (M : F)	25 : 75	22 : 78	0·739
CEAP clinical score†	3 (1)	3 (1)	0·667
Duration of disease (years)*	9·2(3·5)	10·0(4·4)	0·327

*Values are mean(s.d.); †median (interquartile range) Clinical Etiologic Anatomic Pathophysiologic (CEAP) classification of varicose veins. †Mann–Whitney *U* test.

Table 2 Objective assessment (Hobbs' clinical score) and subjective symptom score

	Objective assessment			Subjective assessment		
	Class A	Class B	Class C + D	Class A	Class B	Class C + D
Group 1	4 (4·0)	25 (25·0)	71 (71·0)	3 (3·0)	23 (23·0)	74 (74·0)
Group 2	85 (85·0)	15 (15·0)	0 (0)	86 (86·0)	14 (14·0)	0 (0)

Values in parentheses are percentages. See text for details of assessments. $\chi^2 = 301{\cdot}07$, 6 d.f., $P < 0{\cdot}001$.

Table 3 Duplex assessment after 1 and 3 years

	1 year				3 years			
	Group 1 ($n = 100$)	Group 2 ($n = 100$)	Odds ratio*	P†	Group 1 ($n = 100$)	Group 2 ($n = 100$)	Odds ratio*	P†
Recurrence of SFJ reflux	58 (58·0)	2 (2·0)	67·7 (15·8, 290·1)	< 0·001	71 (71·0)	3 (3·0)	79·2 (23·2, 270·2)	< 0·001
Recurrence from new incompetent tributary	4 (4·0)	5 (5·0)	1·2 (0·4, 3·7)	0·783	7 (7·0)	6 (6·0)	1·2 (0·4, 3·7)	0·783
Recurrence at site of tributary ligation	4 (4·0)	4 (4·0)	1·0 (0·2, 4·1)	1·000	4 (4·0)	5 (5·0)	0·8 (0·2, 3·0)	1·000
Overall GSV recurrence	66 (66·0)	11 (11·0)	17·5 (8·0, 37·9)	< 0·001	82 (82·0)	14 (14·0)	31·5 (14·4, 68·6)	< 0·001

Values in parentheses are percentages unless indicated otherwise; *values in parentheses are 95 per cent confidence intervals. SFJ, saphenofemoral junction; GSV, great saphenous vein. †Fisher's exact test (two-tailed).

whom had Hobbs' score A or B and self-assessment class A or B.

Duplex imaging

At the 1-month control scan, none of the legs had residual GSV reflux. The results of duplex imaging at 1 and 3 years are shown in *Table 3*. After 3 years, the overall recurrence rate of reflux in the GSV in group 1 was 82·0 per cent. In contrast, the overall recurrence rate in group 2 was 14·0 per cent, with a negligible rate of recurrent reflux at the SFJ (3·0 per cent), demonstrating the predictive value of the proposed duplex protocol. A small number of limbs had recurrent reflux at the site of previous tributary ligation: 4·0 and 5·0 per cent in groups 1 and 2 respectively.

Discussion

A number of new open and endovenous procedures for varicose veins do not require obliteration of the SFJ[14–20]. Despite this, reliable means to predict the outcome of varicose vein surgery without disconnection of the SFJ are lacking. The main finding of the present study was that preoperative duplex assessment could predict which legs would develop recurrent incompetence after varicose vein surgery: results were superior in legs with a positive RET result and a competent terminal valve of the common femoral vein.

In this study, a positive RET result was found in 445 (58·3 per cent) of 763 patients with primary chronic venous disease, confirming previous studies that showed a range of 65–76 per cent[14–17]. Moreover, the finding of a competent terminal valve was more common than usually thought: 281 (63·1 per cent) of 445 legs in the present study. Cappelli and co-workers[26,27] reported terminal valve competence in 45 per cent of legs, whereas Somjen and colleagues[34] and Van Bemmelen *et al.*[35] recorded 56 per cent and 78 per cent respectively. Thus, in current practice, application of the proposed duplex protocol could identify a group of about half of the patients with varicose veins who could benefit from a minimally invasive surgical approach, without the need for saphenofemoral ligation. Avoiding a surgical procedure in the groin could eliminate the critical step in the aetiology of SFJ recurrence.

In this study of varicose vein surgery without SFJ disconnection, 85·0 per cent of patients with a competent terminal valve was assessed as Hobbs' class A and 15·0 per cent as Hobbs' class B after 3 years, with physiological forward flow (no reflux) in the GSV. The overall varicose vein recurrence rate was 14·0 per cent. This result is competitive with any other modern technique[2–4,7–20,36].

A competent terminal valve may be expected to maintain its function: only 3·0 per cent of recurrences arose from the untreated SFJ. In patients with an incompetent terminal valve, the risk of recurrence was much higher, as reflux reappeared at the SFJ in 71·0 per cent of legs. In these

patients, SFJ disconnection may well be an important component of the surgical procedure. Data are not yet available concerning the outcome of patients undergoing endovenous ablation for GSV incompetence according to preoperative assessment of the terminal valve.

The duration of follow-up was relatively short in the present study and the fate of the terminal valve after 3 years remains unknown. Future follow-up will be important. Another finding was the presence of a significant rate of recurrence as a result of surgical error, as approximately 5 per cent of recurrence occurred at the site of tributary ligation. Leaving a stump of the tributary in the GSV may have been the cause; this occurred equally in the two groups. A further consideration could be that increasing experience of the CHIVA-2 procedure past the learning curve may improve its final success rate with the present indication.

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