Ultrasound-guided foam sclerotherapy is a safe and clinically effective treatment for superficial venous reflux

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Objective: **To test the hypothesis that ultrasound-guided foam sclerotherapy (UGFS) is a safe and durable treatment for superficial venous reflux (SVR) associated with CEAP clinical grade 2-6 disease.**

Methods: **This was an interrogation of a prospectively gathered computerized database.**

Results: **Between March 23, 2004 and December 31, 2009, 977 patients (1252 legs) underwent UGFS for unilateral (702 legs) or bilateral (550 legs) SVR in association with CEAP clinical grade 2-3 (n = 868), 4 (n = 232), or 5/6 (n = 152) disease. The following reflux in 1417 venous segments was treated: primary great saphenous vein (GSV) (n = 745); recurrent GSV (n = 286), primary small saphenous vein (SSV) (n = 189), recurrent SSV (n = 50); primary anterior accessory saphenous vein (AASV) (n = 93); recurrent AASV (n = 46); vein of the popliteal fossa (VOPF) (n = 5), and Giacomini vein (GV) (n = 3). Three hundred forty-eight legs (27.8%) had undergone previous surgery. Three patients suffered post-UGFS deep vein thrombosis (DVT) and one a pulmonary embolus (PE), all within the first month (0.4% venous thrombo-embolic complication rate). Five patients (0.5%) had transient visual disturbance at the time of, or shortly after, treatment. No other neurologic or serious complications were reported. During a mean (range) follow-up of 28 (<1 to 68) months, 161 (12.9%) legs underwent a further session of UGFS for truncal VV at a mean (range) of 17 (<1 to 63) months following the first treatment. In 52 legs, retreatment was due to the development of new SVR and in 109 legs was for true recurrence (8.7% complete or partial recanalization rate leading to treatment). There was no significant difference in retreatment rates between UGFS for GSV and SSV reflux or between UGFS for primary or recurrent disease.**

Conclusion: **UGFS for CEAP 2-6 SVR is associated with a low complication and retreatment rate. However, as patients are at risk of developing recurrent and new SVR they should be kept under review. Further UGFS for new or recurrent disease is simple, safe, and effective. (J Vasc Surg 2010;52:939-45.)**

Ultrasound-guided foam sclerotherapy (UGFS) is widely used in the UK and many other countries to eradicate superficial venous reflux (SVR).[1-9] UGFS leads to significant improvements in symptoms, venous hemodynamics,[10] and disease-specific and generic health-related quality of life[11,12] and is also associated with high levels of patient satisfaction[13] and significantly less morbidity and a quicker return to normal activities than surgery.[14] In the short term, the results of UGFS, radiofrequency (RFA), and endovenous LASER ablation (EVLA) appear quite similar[15,16] although UGFS is probably more cost-effective.[17] There have been some concerns about bubbles within the foam reaching the systemic circulation via a patent foramen ovale (PFO), and there have been a small number of case reports of transient neurologic events following UGFS. The etiology of these isolated events remains to be determined and further studies are required.[18-21] However, the fact that visual disturbances have been reported following liquid sclerotherapy suggests that mechanisms unrelated to bubbles, such as vasospasm from the sclerosant itself or secondary to vasoactive moieties released from venous endothelium as it is destroyed, may be involved.

In the United Kingdom, after much debate and scrutiny of the available data, the majority of vascular surgeons and other groups treating venous disease have come to regard UGFS as a safe treatment. This now settled view is shared by the National Institute of Health and Clinical Excellence (NICE) (http://guidance.nice.org.uk/IPG314), the National Health Service (NHS), and the major private insurance companies. We understand that although UGFS is practiced quite widely in the United States, the FDA has not yet approved it. We have been performing UGFS in significant numbers in the NHS since 2004. The hypothesis we wished to test is that UGFS is a safe and durable treatment for SVR associated with CEAP clinical grade 2-6 disease.

METHODS

Patients

Local ethical committee approval and written informed consent were obtained. Since March 23, 2004, consecutive UK NHS patients referred by their general practitioners

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because of symptomatic SVR (CEAP C_{2-6})[22] have been enrolled in a dedicated follow-up program. Data have been prospectively entered into a computerized database. Treatment is not offered on the NHS for purely cosmetic indications or, usually, for non-truncal reflux. Thus, all study patients had physical symptoms and signs secondary to venous hypertension as a result of significant (>0.5 seconds) reflux on duplex ultrasonography (DUS) in one or more of the following segments: great saphenous vein (GSV); anterior accessory saphenous vein (AASV); small saphenous vein (SSV); vein of the popliteal fossa (VOPF); or Giacomini vein (GV). Patients with an ankle-brachial pressure index <0.8 or significant postthrombotic deep venous disease are not offered UGFS; such patients are treated conservatively in the majority of cases.

UGFS technique

All the cases were undertaken by two vascular surgeons (A.W.B. and D.J.A.) who used an identical technique that has been described in detail elsewhere.[10-14] However, to summarize, following informed written consent, incompetent truncal veins, their major tributaries, and superficial varices are marked using DUS.[12] With the patient supine, 18, 20, or 22G cannulae (Optiva 2; Smith's Medical, Watford, UK) are inserted into the marked veins under DUS using local anesthetic. The cannulas are usually, but not always, pointing cranially. Tumescent anesthesia is not used. We elevate the leg as high as possible (usually 30-45 degrees) bearing in mind patient comfort and flexibility. Air (2 mL) and 0.5 mL of sodium tetradecyl sulphate (STS) (Fibrovein; STD Pharmaceuticals, Hereford, UK) is agitated 10 times between two 2 mL syringes connected by a three-way tap and a 5-micron filter (B Braun Medical, Sheffield, UK) to produce foam (Tessari technique). Interfascial trunks and major tributaries are usually treated with 3%, and extrafascial veins usually with 1%, STS foam. Foam aliquots (2-2.5 mL) are injected slowly over 10 to 15 seconds though each cannula in turn usually working proximal to distal on the leg. With the leg elevated, the foam often spreads upward. Therefore, when one has injected, for example, the proximal thigh GSV one often finds foam in calf varices. However, other practitioners commence injections distally, and we are not aware of any data that indicate the superiority of one method over the other.

We aim to introduce "fresh" foam every 15 to 20 cm down the trunk vein and major tributaries to be treated, although there is no evidence to support that specific distance. The progress of the foam is followed carefully with DUS. By injecting slowly, waiting for spasm to occur and applying pressure over junctional and nonjunctional perforators, the volume of foam used and the deep passage of foam can be minimized. If foam is observed in communicating or axial veins below the fascia, the injection is stopped and the patient asked to dorsi- and plantar-flex his or her ankle. Only when the foam has cleared are foam injections recommenced. In addition, the patient dorsi- and plantar-flexes his or her ankle 10 times between each injection. We leave a minimum of 30 seconds between each injection. Although this is a non-evidenced-based time period, the rationale is to minimize the amount of foam being used. It takes about 15 to 20 seconds to make each aliquot. Unpublished experimental studies suggest that it takes about 20 to 30 seconds for STS to exert its full effects (spasm and destruction of the endothelium) before being deactivated through protein binding.

The total volume of foam used depends, of course, upon the size of the veins and to what extent they collapse when the leg is elevated and foam is injected (reduction in dead space through reduced venous pressure and spasm). However, typically 1 mL of foam (0.25 mL STS) is treating about 7.5 to 10 cm of vein. However, rather than try to achieve some arbitrary foam volume/vein length "dose" we recommend introducing sufficient foam such that all veins are in spasm and full of foam as observed by DUS.

Rolls of orthopedic wool are then applied over the trunk and major tributaries and held in place with lightweight non-stretch bandage (Peha-Haft; Paul Hartmann Ltd, Heywood, UK). A full-length class II stocking (Credelast; Credenhill, Ilkeston, UK) is fitted and held in place with a waistband. This bandage-stocking combination produces a mixture of concentric and eccentric, elastic and inelastic compression, and is applied while the leg is still elevated. The patient then stands, gets dressed, and immediately walks around the treatment center for 15 minutes before reporting back; if all is well, he or she goes home. We advise on the way home that he or she gets out of the car every hour and walks around for 10 minutes; and then that he or she walks a minimum of 5 minutes every hour he or she is awake for the first week.

The bandage and stocking are left intact for 5 or 7 days, depending on the size of the veins, after which they are removed and a clean class II stocking is refitted and worn for the remainder of the first month. For 1 week, it is worn 24 hours; for the last 2 weeks, the stocking can be removed at night. Patients are provided with a 24/7 "help-line" telephone number.

Although not evidenced-based, at the end of the procedure once compression has been applied, a single dose of subcutaneous low-molecular weight heparin (LMWH) (20 mg-40 mg enoxaparin, Clexane; Sanofi Aventis, Guildford, United Kingdom) is given selectively to older, immobile patients; those with confirmed previous deep vein thrombosis (DVT); those with CEAP 5-6 disease; and in those with known inherited or acquired thrombophilia. Anticoagulants (warfarin) and antiplatelet agents (aspirin, clopidogrel) are not discontinued. Antibiotics are not given except in the rare case where an ulcer is infected with β-hemolytic streptococcus or *Staphylococcus aureus.* Only one patient has required another form of treatment and that was phlebectomy (please see below).

Most patients are offered a review appointment at 1 month. However, we often see older, frailer patients, especially those with CEAP C5/6 disease, back at 5 to 7 days to remove the bandages, dress the ulcer as required, and refit the stocking. Patients who telephone before 1 month are

always offered an earlier review appointment although usually the situation can be dealt with by telephone.

Outcome measures and follow-up

Patients attend the clinic at 1 and 12 months and then annually but are encouraged to contact us through the "help-line" at any time should they have concerns; wish a further assessment or treatment; or experience any side effects or problems. Patients are specifically asked about visual disturbance and any other neurologic symptoms. Repeat DUS is performed at each follow-up visit. Patients found to have residual, recurrent (recanalization), or new truncal reflux are offered further UGFS.

RESULTS

Patients and first UGFS treatments

Patients, legs, and reflux. Between March 23, 2004 and December 31, 2009, 977 patients (1252 legs) underwent a first UGFS for unilateral (702 legs) or bilateral (550 legs) SVR in association with CEAP clinical grade 2-3 (n = 868), 4 (n = 232), or 5/6 (n = 152) disease. Seventeen patients had suffered bleeding; two were treated as an emergency for major hemorrhage that had led to hospital admission. There were 638 left and 614 right legs. There were 810 female legs of mean age (range) 53.2 (16-88) years and 442 male legs of mean age (range) 55.2 (20-87) years. Legs treated were 36 in 2004 (from March), 125 in 2005, 244 in 2006, 300 in 2007, 300 in 2008, and 247 to end 2009. The following reflux was treated: primary GSV (n = 745), recurrent GSV (n = 286), primary SSV (n = 189), recurrent SSV (n = 50), primary AASV (n = 93), recurrent AASV (n = 46), VOPF (n = 5), and GV (n = 3). Overall, 348 (27.8%) legs had been previously operated at least once for truncal VV in the same system. One leg had previously undergone unsuccessful RFA elsewhere. Fifteen legs had been previously affected by confirmed DVT. Twelve patients were treated while on warfarin, (INR 2.5-4.5) for previous DVT (10); atrial fibrillation (1), and a mechanical aortic valve (1).

Numbers of cannulae. Prior to 2006, most procedures were undertaken with one cannula at the mid-point of the vein (usually GSV) to be treated. From 2006, the use of multiple cannulas became increasingly common and more patients were treated for SSV and AASV reflux. In 986 first UGFS treatments undertaken after January 1, 2006, the number of cannulae used were: one (n = 108), 2 (n = 289), 3 (n = 245), 4 (n = 159), 5 (n = 87), 6 (n = 49), 7 (n = 29), 8 (n = 13), 9 (n = 4), 10 (n = 2), and 11 (n = 1).

Volume and concentration of foam. In 1017 first UGFS treatments undertaken after January 1, 2006, 3% STS foam was used in 803; 3% and 1% STS foam was used in 186; and 1% STS foam was used in 28 treatments. The volumes of 3% and 1% STS foam used are shown in Fig 1. Fifteen patients were also treated with 0.5% STS (volume range 4-8 mL); this was always in combination with 3% and/or 1% STS.

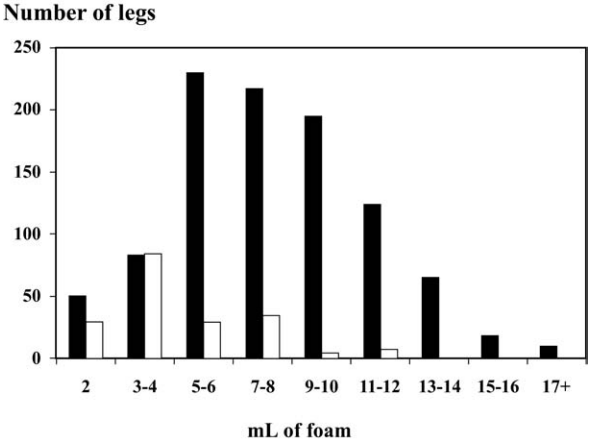


Fig 1. Volume of 3% and 1% sodium tetradecyl sulphate (STS) foam used in 1017 first ultrasound-guided foam sclerotherapy (UGFS) treatments performed after January 1, 2006.

One-month follow-up

At 1 month, 141 (11.3%) patients failed to attend and 1056 (84.4%) reported no complications or side effects. Thirty (2.4%) legs underwent duplex-guided aspiration of retained thrombus (2-5 mL) under local anesthesia. Three patients complained of "lumpy" legs but declined aspiration. Three reported they had suffered "phlebitis," but this had settled spontaneously. At the clinic, no specific treatment other than topical nonsteroidal anti-inflammatory gel was deemed necessary. One had been prescribed antibiotics by his or her family doctor. One complained of headaches and nosebleeds but this predated UGFS and settled spontaneously without specific treatment. One complained of an "allergy" to the stocking that was probably an area of pressure erythema and settled spontaneously. One developed a facial rash after 24 hours that disappeared spontaneously and no treatment was necessary. Three complained of pain in the treated leg that was musculoskeletal and/or stocking-related. One developed an in-grown toenail that may have been related to compression; this was treated conservatively and settled quickly. Five complained of transient visual disturbance at the time or shortly after treatment; one patient had developed this twice (after each leg was treated). These were all self-limiting and no other neurology was reported or recorded. Three complained of headache immediately following treatment. Two of these were known to suffer from migraine. All settled with simple analgesia within 24 hours. At 1 month, six truncal veins remained at least partially patent and were still refluxing; one declined further treatment; one requested surgery (this was multiple phlebectomies and the only "cross-over" to another treatment modality); three underwent immediate repeat (successful) UGFS; and one underwent immediate repeat (unsuccessful) UGFS and then went on to have a third session of UGFS which was successful. It is possible that there was an issue with compliance with compression in this last patient.

Table I. Deep vein thrombosis and pulmonary embolus after ultrasound foam sclerotherapy

Patient 1	A 58-year-old woman who underwent UGFS for primary left SSV CEAP C2 VV in November 2006 using 6 mL of 3% STS foam delivered through a single cannula placed in the SSV at its midpoint in the posterior calf. There was no significant past medical history, no known prothrombotic predisposition, and all deep veins were normal prior to UGFS. The patient had undergone uneventful UGFS of right primary SSV a month earlier. One week following treatment she returned with pain in the leg and DUS showed a 4 cm occlusive thrombus in the popliteal vein at the level of the sapheno-popliteal junction (SPJ). The patient was treated with low molecular weight heparin (LMWH) and then warfarin for 6 months. The popliteal vein recanalized but does now exhibit reflux although the patient is asymptomatic. At 36 months following UGFS, the SSV remains occluded and no further treatment for VV has been required.
Patient 2	A 58-year-old woman who underwent UGFS for primary left GSV CEAP C2 VV in October 2007 using 8 mL of 3% STS foam delivered through two cannulae placed in the GSV at mid-thigh and just below the knee. The patient had undergone uneventful UGFS of right primary GSV a month earlier. There was no known prothrombotic predisposition, and all deep veins were normal prior to UGFS. The patient was on methotrexate for psoriatic arthropathy. Three days after the second treatment the patient was involved in a road traffic accident (RTA). Two days following the RTA, a DVT affecting the mid superficial femoral vein (SFV) was diagnosed. The patient was treated with low molecular weight heparin (LMWH) and then warfarin for 12 months. Thrombophilia testing was negative. At 24 months following UGFS, the SFV had partially recanalized and exhibited moderate reflux. The GSV remained occluded and there were no visible VV. There were no skin changes or swelling, both calves being of equal circumference.
Patient 3	A 65-year-old woman and heavy smoker (50 pack years) with a history of previous right leg superficial thrombophlebitis. She underwent UGFS for primary right GSV CEAP C2 VV in June 2009 using 12 mL of 3% STS foam delivered through six cannulae. Three weeks following treatment, the patient was admitted under the care of the respiratory physicians with left sided chest pain. She was diagnosed as having pneumonia, which was confirmed on chest X-ray. She was prescribed antibiotics and discharged the same day. She attended A&E 2 weeks later with further breathing problems. Chest X-ray at this time showed that the lungs were clear. She was admitted and underwent CT pulmonary angiogram that revealed a small left lower lobe PE. She was also diagnosed with swine flu at this time. She was anticoagulated and discharged home. Both her father and son have had confirmed PE in the past.
Patient 4	A 44-year-old obese woman who underwent UGFS for recurrent right GSV CEAP C4 VV in September 2009 using 8 mL of 3% and 8 mL of 1% STS foam delivered through six cannulae, two placed in the GSV and four in the very large and extensive superficial varices. She attended A&E 4 weeks posttreatment complaining of pain in the leg and was diagnosed with a calf vein DVT (posterior tibial and peroneal veins) and commenced LMWH and 3 months warfarin. She is asymptomatic in the treated leg but has yet to attend 12-month DUS follow-up.

DUS, Duplex ultrasonography; *GSV,* great saphenous vein; *SSV,* small saphenous vein; *UGFS,* ultrasound-guided foam sclerotherapy.

Post-UGFS deep vein thrombosis and pulmonary embolus

Three patients developed symptomatic DVT and one a symptomatic pulmonary embolus (PE), all during the first month following treatment (Table I). No asymptomatic DVT were detected on DUS during follow-up. It is possible to speculate that the PE might have been avoided had first follow-up been conducted prior to 4 weeks.

Deaths

Six patients have died since treatment: one following revisional hip arthroplasty; one from colon cancer; one from cardiac and renal failure 3 years post-foam; one from rectal carcinoma 9 months post-foam; two patients treated for C6 died ulcer free of old age at 90 and 91 years 2 and 4 years after UGFS, respectively.

Further UGFS treatments

During a mean (range) follow-up of 28 (<1 to 68) months, 161 (12.9%) legs underwent a further session of UGFS for truncal VV at a mean (range) of 17 (<1 to 63) months. Of these, 122, 14, and 25 had initially undergone UGFS for GSV, AASV, and SSV reflux, respectively. Second UGFS treatments were performed for recurrent reflux (recanalization) in 109 legs and for new reflux in a previously untreated vein in 52 legs (Table II).

Freedom from reintervention for all 1417 treated truncal segments is shown in Fig 2. There was no significant difference in overall (recurrent and new reflux combined) retreatment rates following first UGFS for GSV and SSV reflux (Fig 3) or following first UGFS for primary or recurrent disease (Fig 4). However, the recanalization rate was significantly lower following first UGFS for AASV than for GSV reflux ($P = .044$, Fisher exact test, two tailed). There was no significant difference in recanalization rates between GSV and LSV or between AASV and LSV reflux (Table II).

A third UGFS treatment was undertaken in 14 legs between 5 and 42 months after the second treatment. In nine legs, this was for further recanalization (GSV eight legs, SSV one leg) and in five legs, this was for a new disease. There were no recorded significant side effects or complications following these second or third treatments.

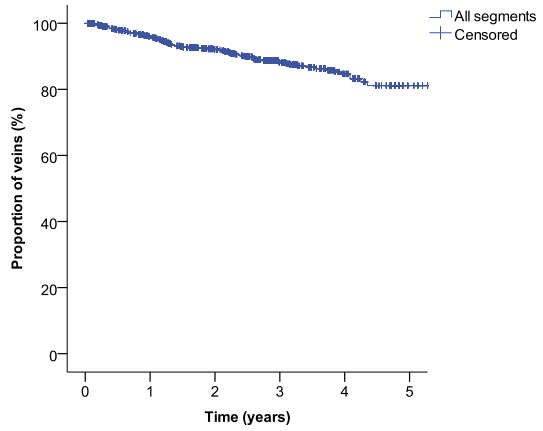
DISCUSSION

Until some 5 years ago, most UK vascular surgeons had dismissed sclerotherapy as an effective treatment for truncal VV.[23] Therefore, when approached to take part in the Varisolve European Phase III trial, we were reasonably confident of the likely outcome. However, it became rapidly apparent that UGFS could effectively eradicate SVR and offered significant advantages over surgery.[15] So, when

Table II. Second UGFS treatments for recurrent (recanalization) and new reflux

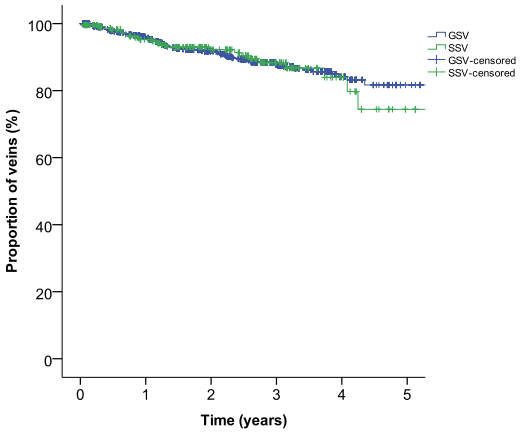
First treatment	*GSV reflux N = 1031*	*AASV reflux N = 139*	*SSV reflux N = 239*
Legs (%) requiring second UGFS	122 (11.8)	14 (10.1)	25 (10.5)
Mean (range) follow-up (months)	41 (6-68)	35 (8-64)	32 (9-66)
Recurrent reflux (n = 109)			
GSV[a]	87	—	—
AASV	—	5	—
SSV	—	—	17
Recanalization rate	8.4%	3.6%	7.1%%
New reflux (n = 52)			
GSV[b]	13	9	6
AASV	14		
SSV	8		
VOPF	—	—	2
GV			
New reflux rate	3.4%	6.5%	3.4%

AASV, Anterior accessory saphenous vein; *GSV,* great saphenous vein; *GV,* Giacomini vein; *SSV,* small saphenous vein; *VOPF,* vein of the popliteal fossa.
[a]In previously treated above knee and/or below knee segment of GSV.
[b]In previously untreated below knee segment of GSV.



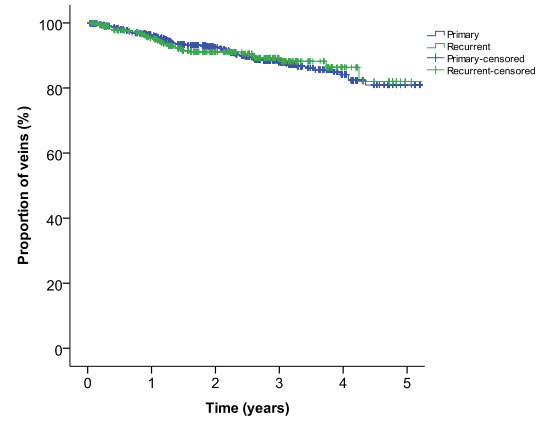
Numbers at risk	1417	1079	680	360	125	25
% free of re-treatment	100	96	92	88	85	81

Fig 2. Kaplan-Meier plot showing freedom for any reintervention of all 1417 treated venous segments.



GSV	Numbers at risk	1031	791	516	274	96	19
	% free of re-treatment	100	96	92	88	84	82
SSV	Numbers at risk	239	180	116	60	20	5
	% free of re-treatment	100	95	92	88	84	74

Fig 3. Kaplan-Meier plot comparing freedom from any re-intervention in patients undergoing ultrasound-guided foam sclerotherapy (UGFS) for great saphenous vein (GSV) (n = 1031) and SSV (n = 239) reflux (P = .701 log-rank test, 95% CI 4.94-5.20).



Primary	Numbers at risk	1035	782	488	273	92	22
	% free of re-treatment	100	96	93	88	82	81
Recurrent	Numbers at risk	382	295	192	87	27	11
	% free of re-treatment	100	95	91	88	86	82

Fig 4. Kaplan-Meier plot comparing freedom from any re-intervention in patients undergoing ultrasound-guided foam sclerotherapy (UGFS) for primary (n = 1035) and recurrent disease (n = 382) (P = .884 log-rank test; 95% CI 4.97- 5.27).

the trial ended, we continued offering UGFS using "home-made" foam. The number of patients referred for UGFS increased rapidly, partly because we attracted work from elsewhere but also because many people who would not contemplate surgery wanted UGFS. Nevertheless, we were still concerned about deep propagation of sclerothrombus and a high recanalization rate. Therefore, fearing venous thromboembolic (VTE) complications and the need to "redo" surgery, we built the UGFS practice slowly and established a research-funded review program. Our fears were unfounded and soon we were treating some 300 legs per annum. More recently, the numbers have fallen because of NHS rationing.[9,24]

Undertaking outcomes research in patients being treated for VV is difficult as they are often young, mobile, and employed and so reluctant or unable to attend follow-up. That said, we believe that our follow-up compares favorably with the rest of the literature.[10-14] Patients who

default from the clinic know that they can contact us any time should they have any concerns or want further assessment or treatment. Had we not worked so hard to maintain contact with the patients we may have reported lower retreatment rates. Standard NHS practice is not to follow patients after VV surgery.

The VTE complication rate compares well with that reported after surgery, RFA, and EVLT; especially bearing in mind of the numbers of older C5/C6 patients.[25-28] All symptomatic DVT/PE occurred within 1 month. No asymptomatic DVTs were observed. It is possible that some DVTs were missed, either because they had resolved before the 1-month follow-up, or occurred between follow-up visits; or because they occurred in patients who defaulted from the clinic. However, it seems unlikely that we are missing significant post-UGFS VTE complications.

Five patients had transient visual disturbances, all self-limiting. We observed no other neurologic or other significant adverse events. This supports the view that the risks of micro-embolism leading to clinically significant adverse outcomes are negligible.[29,30] We have not, therefore, changed from air to carbon dioxide.[31] We undertake no cardiac assessment prior to UGFS and believe that none is necessary.

UGFS creates a controlled thrombophlebitis and every attempt should be made to retain foam within the superficial venous system; any foam observed deep to the fascia should be cleared as quickly as possible.[32] Despite good compression, some patients develop redness and pain over the treated veins, especially in large extrafascial varices close to the skin. In these, 0.5% or 1% STS foam usually achieves occlusion without undue perivenous inflammation. We have adopted an ever lower threshold for DUS-guided aspiration of semi-liquid, sclerothrombus during the first weeks after treatment. It provides instant symptom relief and reduces skin pigmentation, which can develop in up to a third of patients. We inform patients that this may occur and that it will fade over a few weeks or months; only rarely is it permanent.[11,13]

One of the difficulties with interpreting the UGFS literature is that techniques vary considerably.[33] When teaching UGFS, we stress the importance of minimizing foam volumes[34] and concentrations[35] of sclerosant; multiple cannulae to deliver "fresh" foam to each segment of vein (we know foam is quickly de-activated upon contact with blood and endothelial protein); DUS to ensure veins are in spasm and full of foam; the techniques to minimize the spread of foam to the deep venous system; and good compression.

Retreatment rates after UGFS are low and compare favorably with those reported after surgery, RFA, and EVLT.[36-39] Redo UGFS is much simpler and easier than redo surgery, RFA, or EVLT.

About a third of secondary treatments were for the development of new disease. Reflux in the below knee (BK) GSV is one such cause of "recurrence"[40] and we now often treat the whole GSV, even if there is no reflux below knee. Similarly, when treating AASV we will often treat the AK GSV as well, even if it is competent; and when treating AK GSV reflux we make a point of occluding the AASV, too, if present.

We do not, of course, claim that our UGFS technique is the only effective one or, indeed, necessarily the best. However, through good patient communication, procedural attention to detail, a low threshold for early aspiration and repeat treatment, careful follow-up to detect new and recurrent SVR and open telephone access to patients, UGFS has now virtually replaced all other forms of treatment for SVR in our practice. UGFS has the advantage of being extremely versatile, a "complete" treatment usually achieved in one session, and extremely cost-effective. By contrast, we find many patients are unsuitable for catheter-based techniques and many patients undergoing RFA or EVLA require supplementary procedures; they are also much more expensive.

In conclusion, present outcome data on 1252 consecutive legs in 977 patients treated with UGFS over a 5- to 6-year period contribute to the growing worldwide body of evidence that UGFS is a safe, durable, and highly cost-effective treatment for SVR. As with all treatments for SVR, patients are at some, albeit low, risk of developing recurrent and new reflux after UGFS and should be kept under regular review. Further UGFS for new or recurrent disease is simple, safe, inexpensive, and highly effective.

AUTHOR CONTRIBUTIONS

Conception and design: AB, GB, KD, KP, DA
Analysis and interpretation: AB, GB, KD, KP, DA
Data collection: AB, GB, KD, DA
Writing the article: AB
Critical revision of the article: AB, GB, KD, KP, DA
Final approval of the article: AB, GB, KD, KP, DA
Statistical analysis: AB, GB, KD, KP, DA
Obtained funding: AB
Overall responsibility: AB

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