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Recanalisation and ulcer recurrence rates following ultrasound-guided foam sclerotherapy

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Abstract

Objectives: The aim was to assess vein recanalisation and ulcer recurrence in patients with chronic venous ulceration following ultrasound-guided foam sclerotherapy.

Method: Open (CEAP 6) or recently healed (CEAP 5) chronic venous leg ulcers were treated with foam sclerotherapy between July 2010 and August 2012. Venous duplex scans were performed two weeks and one and two years post treatment, recording recanalisation and reflux. One- and two-year ulcer recurrence rates were calculated using Kaplan–Meier survival analysis.

Results: A total of 100 legs were treated in 92 patients; 86 were CEAP 5 and 14 were CEAP 6. At two weeks complete or short segment occlusion was demonstrated in 99/100 legs. Complete follow-up was 93% at one year and 88% at two years. Complete and segmental recanalisation with new reflux was recorded in 11/93 (12%) legs and 25/93 (27%) legs, respectively (overall 36/93; 39%) at one year; and 6/88 (7%) legs and 15/88 (17%) legs, respectively (overall 21/88; 24%) at two years. Kaplan–Meier survival analysis shows 64% ulcers healed at 24 weeks and 86% at one year. Ulcer recurrence rate at one and two years was 2.3% and 5.1%.

Conclusions: Over one-third of superficial veins treated with foam sclerotherapy recanalised at one year and just under a quarter of superficial veins recanalised at two years. Despite this, ulcer recurrence rates were low, and recanalisation failed to predict recurrence.

Keywords

UGFS, foam sclerotherapy, chronic venous ulcer, recanalisation

Introduction

Chronic venous ulceration (CVU) is a debilitating condition associated with reduced quality of life and a major financial burden in terms of both medical care costs and loss of work hours.[1] CVU results from the effects of ambulatory venous hypertension upon the dermal microcirculation caused by superficial and deep venous reflux.[2] Venous duplex ultrasound (DUS) has become the mainstay of lower leg venous assessment in patients with CVU and allows the clinician to determine the site and extent of reflux.[3]

Superficial venous surgery treats underlying venous reflux in legs with superficial venous incompetence and may improve venous hypertension. In 2004, the ESCHAR trial showed that abolition of superficial venous reflux through superficial venous surgery, combined with compression therapy significantly reduced ulcer recurrence at one year compared with compression alone.[4,5] Recently, endovenous techniques have largely replaced surgery in the abolition of superficial venous reflux.[6–9] Among the endovenous options, ultrasound-guided foam sclerotherapy (UGFS) is versatile and has been shown to successfully eradicate venous reflux.[10] Furthermore, UGFS is associated with a faster recovery and less post-procedure pain

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than superficial venous surgery with comparable ulcer healing and recurrence rates.[11,12]

However, despite UGFS short-term efficacy, its long-term durability has been questioned compared to other treatment modalities.[6,9] The CLASS trial by Brittenden et al. randomised 798 participants from multiple centres to compare outcomes of UGFS, laser and surgical treatments for primary varicose veins and demonstrated that successful ablation of the main trunks of the saphenous vein was less common in the foam group than the surgery group at six weeks and six months post treatment.[9] Rasmussen et al.[6] randomly allocated patients with great saphenous vein incompetence to four different treatment modalities and demonstrated that recanalisation at one year was three fold greater in the UGFS group (16.3% UGFS; 5.8% laser; 4.8% radiofrequency and 4.8% surgery). Other reports of recanalisation rates following UGFS are more variable,[1,6,7,13–17] but these studies included only CEAP 2–4 patients with very few studies focusing on the impact of UGFS recanalisation on ulcer recurrence.

As the lack of long-term durability in UGFS has previously been highlighted, this raises the question as to whether this recanalisation is clinically relevant and associated with ulcer recurrence. This study sought to determine the initial treatment efficacy, subsequent vein recanalisation and ulcer healing and recurrence in patients with CVU.

Methods

Patients and setting

The cohort consisted of consecutive patients presenting with active or recently (within six months) healed leg ulcers to a nurse-led specialist leg ulcer service between July 2010 and August 2012. Patients were seen in a one stop vascular assessment in which the venous aetiology was confirmed through a colour venous DUS performed by an accredited vascular scientist. The DUS involves an assessment of the deep veins (i.e. common femoral vein (CFV), superficial femoral vein (SFV) and popliteal vein) and superficial veins (i.e. sapheno-femoral junction, above and below knee great saphenous veins (GSV), thigh perforating veins, sapheno-popliteal junction, short saphenous veins (SSV) and calf perforating veins). Reflux was quantified by $\geq$1 s of retrograde flow. Clinical examination and measurement of ankle brachial pressure index (ABPI) were also performed. All suitable patients confirmed with superficial venous reflux (>1.0 s) and an ABPI > 0.85 went onto have UGFS. Patients with deep vein or occlusion were not considered for treatment with UGFS. Patients with bilateral leg ulcers were treated sequentially.

UGFS

UGFS was performed in an outpatient setting using local or no anaesthetic. Patients were positioned supine, in a reverse Trendelenburg position and the target refluxing saphenous trunk or varicosity was identified on duplex.[18] Truncal veins were then cannulated with a 18–22 g cannula and superficial varicosities with a 18 g butterfly, the cannulation process was duplex guided, where necessary. Sclerosant foam was prepared by mixing 3% sodium tetradecyl sulphate (Fibrovein, STD pharmaceuticals Ltd, Hereford, UK) and air (1:4) by using 5 ml and 2 ml syringe and a three-way tap as described by Tessari.[19] The patients were then placed into Trendelenburg position and the foam injected under ultrasound guidance. Foam was deliberately 'milked' into incompetent tributaries. On completion of the injection, the patients were asked to dorsi and plantar-flex their ankle for a short period to help prevent stasis of the foam within the deep venous system. Patients with previous deep vein thrombosis or family history of deep vein thrombosis were covered with one week of fragmin injections from the time of UGFS.

Post-procedure compression

Post-procedure, treated legs were placed into full length compression bandaging. Those with active leg ulceration continued to wear multi-layer compression bandaging below the knee and a class 2 compression stocking above the knee (Duomed, Medi, Hereford, UK) for two weeks, and then remain in multi-layer compression until the ulcer has healed. In patients with healed ulceration, a Coban eccentric compression bandage (Profore, Smith & Nephew, Hull, UK) and full length class 2 compression stocking were left in-situ for two days. The full length stocking was subsequently worn without the Coban bandage until two weeks post treatment. After two weeks or upon healing, patients continued to wear below-knee class 2 compression stockings. Immediately following treatment, patients were advised to go for a 10 min brisk walk before leaving the hospital grounds and were asked to keep as mobile as possible for the remainder of that day.

Follow-up duplex surveillance

Patients underwent venous DUS (Philips IU22) within two weeks post UGFS to determine initial treatment efficacy. The DUS was performed by an accredited vascular scientist to assess the deep (i.e. CFV, SFV and popliteal vein) and superficial veins (i.e. sapheno-femoral junction, above and below knee GSV, thigh perforating veins, sapheno-popliteal junction, SSV and calf perforating veins). Complete occlusion of the treated superficial veins was defined as a length of 85%

or more closure of the treated saphenous trunk or tributary with abolition of reflux.[10] Anything less than 85% was defined as 'short-segment occlusion' and a persistently patent vein following UGFS was defined as 'incomplete occlusion'. To determine long-term occlusion rates, a further venous DUS was performed at one year and two years following UGFS. A venous segment which had remained treated at one year was seen as a fibrous cord and was defined as 'occluded'. Segmental recanalisation was defined as a reduction in the length of the occlusion, and complete recanalisation was defined as a patent lumen in a previously occluded vein. Direction of flow in the patent segments was also determined and labelled as competent or incompetent. Presence of Endovenous Foam Induced Thrombosis (EFIT)[20] detected on duplex as a complication was documented.

Post-treatment assessment

Patients with active ulceration were reviewed in a specialist nurse-led ulcer clinic at least once a month until the ulcer was healed, alongside shared weekly care with a district nurse, and at one, three, six and 12 months thereafter.[18] Patients then were followed up annually in a 'Well Leg Clinic' and data for ulcer healing and recurrence were entered prospectively into a study database.

Retreatment at one year

Patients demonstrating complete or segmental recanalisation and reflux on DUS at one year were offered further treatment.

Statistical analysis

Results were analysed using Statistical Package for Social Sciences (SPSS for windows, version 22.0, IL, Chicago, USA). Twenty-four week healing rates were measured for active ulcers from treatment to healing using Kaplan–Meier Survival analysis. Survival analysis was also used to determine one-year and two-year ulcer recurrence for healed ulcers from time of treatment to recurrence and for active ulcers from the healing date.

Results

A total of 100 legs in 92 patients with either active (n = 14) or recently healed (n = 86) ulcers were treated with UGFS between July 2010 and August 2012. The median size of active ulcers was 4.3 cm^2 (range 1–15.75 cm^2) with a median chronicity of five months (range 2–36 months). The median age of patients was 74 years (range 40–90). Of the 100 legs, venous segments treated with UGFS, 52 were GSV, 16 were SSV, 23 were anterior accessory saphenous veins, medial or lateral thigh veins and 9 were below knee calf veins (Table 1). In five legs, both the GSV and SSV were treated. The median volume of foam used was 4 ml (1 ml–10 ml).

Table 1. Patient demographics and clinical characteristics.

n = 100	CEAP 5 n = 86	CEAP 6 n = 14
Demographics		
Male	48 (56%)	7 (50%)
Female	38 (44%)	7 (50%)
Age (years, median)	74	78
Reflux pattern on duplex		
Isolated SVR	64 (74%)	12 (86%)
Mixed segmental deep and SVR	18 (21%)	2 (14%)
Mixed total deep and SVR	4 (5%)	0 (0%)
Refluxing segment on duplex		
GSV	45 (52%)	7 (50%)
SSV	14 (16.25%)	2 (14%)
Anterior accessory vein	3 (4%)	1 (7%)
Medial thigh vein	14 (16.25%)	4 (29%)
Lateral thigh vein	1 (1%)	0 (0%)
Medial calf vein	9 (10.5%)	0 (0%)
Primary veins	72 (84%)	11 (79%)
Recurrent veins	14 (16%)	3 (21%)

SVR: superficial venous reflux; GSV: great saphenous vein; SSV: short saphenous vein.

UGFS efficacy at two weeks

The mean number of treatment sessions per leg was 1.1, with 11 legs undergoing two treatments and three legs undergoing three treatments. At two weeks, occlusion was achieved in 99/100 legs (99%); complete occlusion in 86/100 legs (86%) and short-segment occlusion in 13/100 legs (13%). One leg, demonstrating reflux in a large >1.5 cm diameter medial thigh vein, remained patent, and this patient went onto have superficial venous surgery.

Complications

Following treatment, thrombophlebitis was seen in 12 patients that resolved with compression hosiery and non-steroidal anti-inflammatory medications. At the two-week duplex scan, two patients had developed limited asymptomatic thrombus protrusion (<25% diameter) into the deep vein (EFIT 1); one was detected in the common femoral vein and the other in the popliteal

vein. Both cases of EFIT 1 showed complete resolution on duplex scanning at three weeks following treatment with aspirin and compression.

UGFS efficacy at one year

Five patients (seven legs) did not attend for a scan at one year, one of these patients died of unrelated causes eight months post UGFS, two patients (three legs) went onto have alternative treatment to their persistent venous reflux following UGFS (two legs underwent endovenous laser treatment; one leg underwent surgery), one patient was not contactable and one patient with bilaterally healed ulceration suffered a debilitating stroke 10 months post UGFS and was unable to attend for the scan.

Ninety-three legs were scanned at one year. Complete occlusion was persistent in 47/93 (50%) and short segment in 10/93 (11%). Complete recanalisation with reflux was seen in 11/93 (12%) legs and segmental recanalisation with reflux was seen in 25/93 (27%) (Figure 1). Twenty-one of 36 legs demonstrating complete or segmental recanalisation and reflux underwent retreatment with UGFS, 9 GSV, 1 SSV and 11 anterior accessory saphenous veins, medial or lateral thigh veins and medial calf veins. In five legs, new reflux was detected in previously competent superficial veins and were offered treatment with UGFS.

UGFS efficacy at two years

A further five patients (five legs) did not attend for a scan at two years, three of these patients died of unrelated causes, the remaining two patients were suffering with unrelated, debilitating illnesses and were unable to attend for the scan.

Eighty-eight legs were scanned at two years. Complete occlusion was persistent in 61/88 (69%) and short segment in 6/88 (7%). Complete recanalisation with reflux was seen in 6/88 (7%) and segmental recanalisation with reflux was seen in 15/88 (17%) (Figure 1).

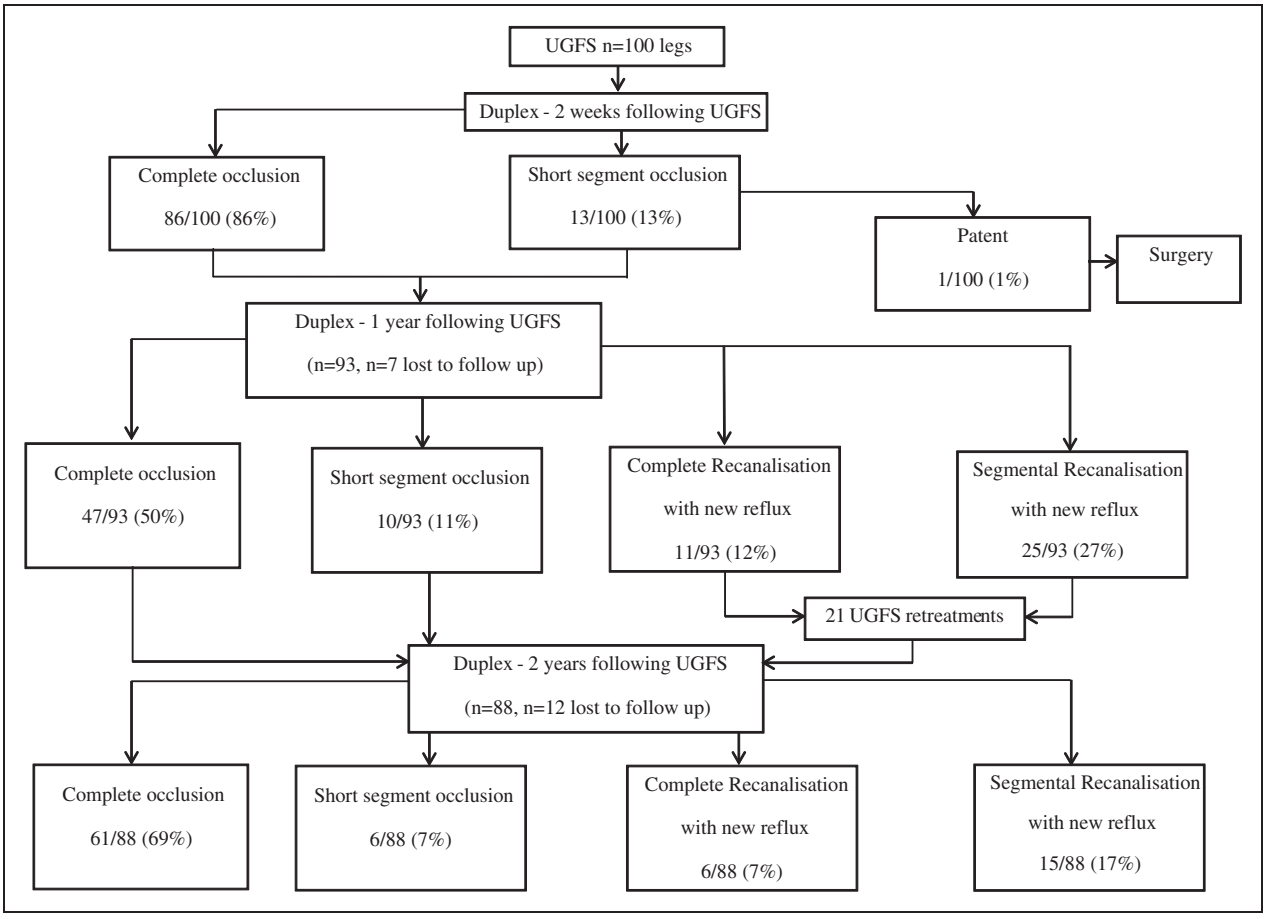

Figure 1. Flow diagram of 100 legs.

Ulcer recurrence

As two leg ulcers failed to heal at one year, 98 legs were assessed for recurrence, of these, seven legs failed to have a duplex scan at one year. One year recurrence rate was 2.3% using Kaplan–Meier survival analysis (Figure 2(a)). At two years, as one leg ulcer remained unhealed, 99 legs were assessed for recurrence; of these 12 legs failed to have a duplex scan at two years. Two-year recurrence rate was 5.1% using Kaplan–Meier survival analysis (Figure 2(a)).

Of the two legs with ulcer recurrence at one year, one showed GSV reflux initially and then segmental recanalisation with reflux one year following UGFS with the recurrence being traumatic in origin. In the second

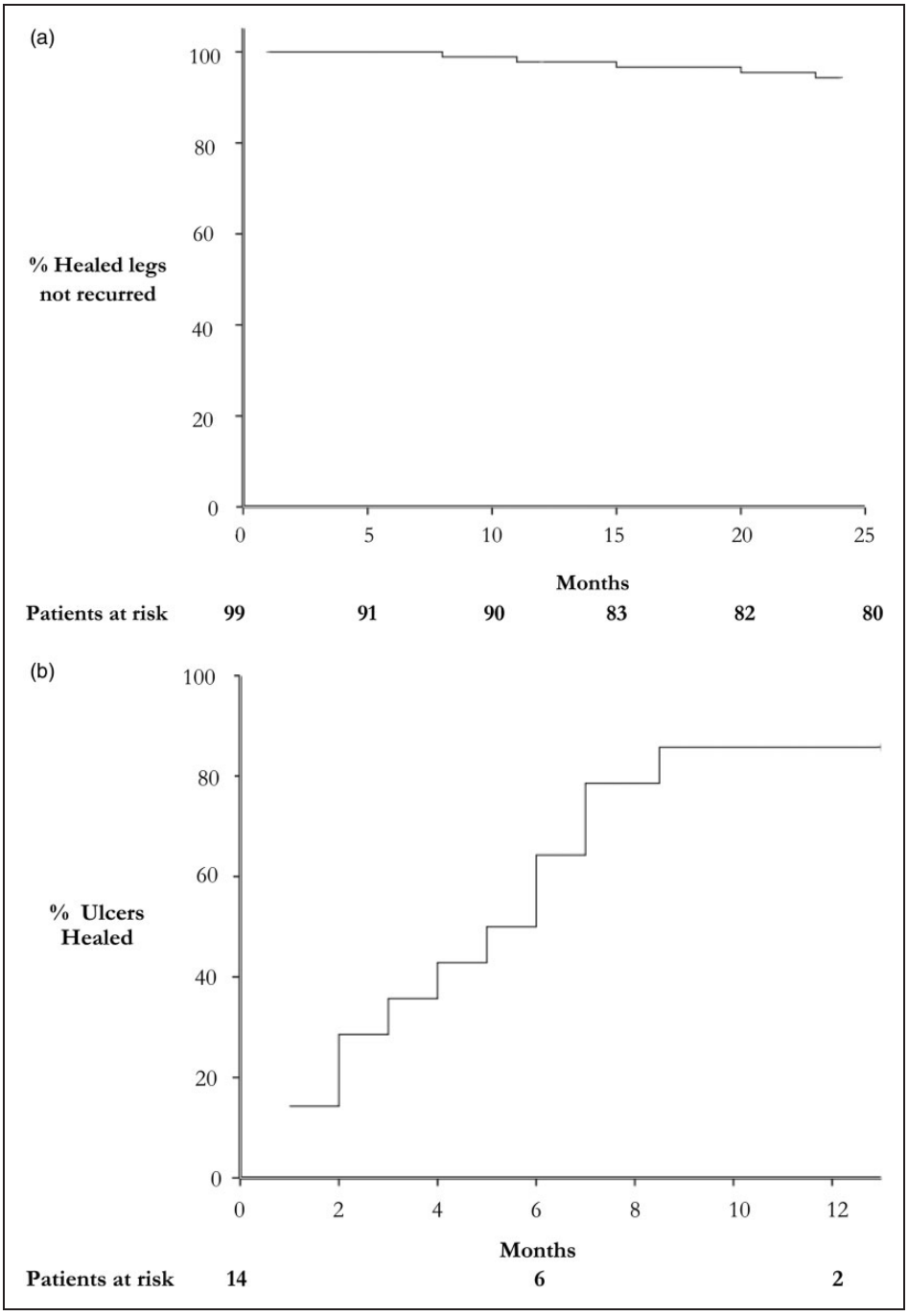

Figure 2. (a) Kaplan–Meier analysis of ulcer recurrence for all healed legs at two years. (b) Kaplan–Meier analysis of ulcer healing for all legs.

patient, SSV reflux was seen initially and following UGFS showed complete occlusion at one year. Of the 91 legs with healed ulcers scanned at one year, 35 demonstrated superficial venous reflux and 56 demonstrated no superficial reflux at one year. Of the 35 legs demonstrating superficial venous reflux, one leg demonstrated ulcer recurrence compared to one of the 56 legs demonstrating no reflux (1/35 vs. 1/56 p = n.s. chi squared test).

At two years, a further four legs demonstrated ulcer recurrence. The first patient demonstrated SSV reflux initially with complete occlusion remaining at one and two years following UGFS. The second patient demonstrated medial calf tributary reflux initially, which remained completely occluded at one year and demonstrated segmental recanalisation at two years. The third patient demonstrated SSV reflux initially with segmental recanalisaton at one year following UGFS; this was retreated and complete recanalisation was demonstrated at two years. The fourth patient also demonstrated SSV reflux initially with complete occlusion remaining at one and two years following UGFS. Of the 87 legs with healed ulcers scanned at two years, 20 demonstrated superficial venous reflux and 68 demonstrated no superficial reflux at one year. Of the 20 legs demonstrating superficial venous reflux, two legs demonstrated ulcer recurrence compared to two of the 68 legs demonstrating no reflux (2/20 vs. 2/68 p = n.s chi squared test).

Ulcer healing

Of the 14 active ulcers at the time of treatment, two ulcers were not healed at one year. One of these ulcerated legs demonstrated reflux in the SSV at the initial duplex, which was ablated by UGFS and demonstrated segmental recanalisation with reflux at one year. The second ulcerated leg demonstrated reflux in the GSV at the initial duplex and complete occlusion at one year. Both cases of delayed healing were attributed to poor mobility and compliance with elevation, although one patient had shown some improvement with the ulcer reducing in size. Kaplan–Meier survival analysis shows 64% ulcers healed at 24 weeks and 86% at one year (Figure 2(b)).

Discussion

The present study confirms that UGFS is efficacious in the early abolition of reflux in treated superficial segments with comparable ulcer healing rates and low ulcer recurrence rates of 2.3% and 5.1% at one and two years, respectively. UGFS is increasingly becoming a 'first-line' treatment for superficial venous reflux in patients with venous leg ulcers, who are often elderly and with significant co-morbidities, with good ulcer healing and recurrence rates.[11,18,21] Whilst this study shows that one in 10 treated veins completely recanalises with development of new reflux after one year of treatment, and over one-third of patients have complete or segmental recanalisation, this lack of durability did not result in increased ulcer recurrence at one year in this small, observational study.

The poor durability of UGFS compared to other treatment modalities has been highlighted previously by Brittenden et al.[9] in the CLASS trial who demonstrated that the ablation rates following UGFS were lower at six months compared to surgery. A number of operator-dependent and patient-specific factors may contribute to recanalisation rates, including volume of foam injected, technique, vein diameter, use of anticoagulants before treatment and evidence of pulsatile flow in the vein prior to UGFS.[12,17] The volume of foam used per treatment has varied widely with Shadid et al.[7] using a median of 5.4 ml of foam to Cabrera et al.[1] using up to 30 ml in the management of venous leg ulcers. Bradbury et al.[12] suggested that a total volume of foam used depends on the size of the vein treated and the extent of collapse of the vein on the leg elevation and recommended that typically 1 ml of foam should treat approximately 7.5–10 cm segment of vein. Previously, we have reported a higher rate of DVTs in patients receiving more than 10 ml of foam, and hence limited the volume of foam used in the present study to less than 10 ml (range 1–10 ml).[20] Whilst this approach may be safer, the use of smaller volumes of foam may account in part for the observed high recanalisation rates at one year.

Although it would seem plausible that recanalisation and further reflux of superficial veins may promote ulcer recurrence, these data fail to support this theory. This could be explained by the fact that the recurrent reflux fails to cause severe venous dysfunction or hypertension or indeed that its duration has been limited and given time would lead to further ulceration. Alternatively, this cohort of patients may be too small and follow-up too short to detect any adverse effect on ulcer recurrence associated with recanalisation. Long-term follow-up of the entire cohort continues and may help clarify the clinical significance of recanalisation following UGFS in due course.

In this study, two ulcers recurred at one year with one leg demonstrating segmental recanalisation with reflux and the other showing no recanalisation. Four ulcers recurred at two years, with two legs demonstrating segmental recanalisation and two showing no recanalisation. It is likely that a number of factors may contribute to ulcer recurrence. Superficial hypertension due to superficial venous reflux is one such factor,[22] but inadequate compression, lack of exercise and limited

elevation may also contribute to sustained venous hypertension predisposing to recurrent ulceration. Furthermore, in patients whose predominant cause of venous ulceration is a poor calf pump mechanism resulting from arthritic joints and calf muscle wasting, correcting minor superficial venous reflux will only have very limited benefit on venous dysfunction.

The importance of venous reflux in ulcer recurrence was previously investigated in a sub-group analysis of the ESCHAR trial,[23] which found that ulcer recurrence at three years was not associated with residual venous reflux detected following surgery, and these findings are consistent with other studies which have found that the overall reflux pattern has little influence on ulcer healing and recurrence rates.[24] As the severity of the venous dysfunction cannot be quantified by duplex ultrasound assessment, measuring venous function with non-invasive techniques may help to determine which patients may be more at risk in predicting ulcer recurrence.

The use of UGFS is an attractive option for elderly or frail patients with venous ulceration caused by superficial venous hypertension who may be at high risk for surgery or endothermal ablation. Given that DUS-detected recanalisation during surveillance failed to predict ulcer recurrence at one or two years in this small, observational study, the utility of routine DUS follow-up following clinically successful UGFS remains unknown.

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References

1. Cabrera J, Redondo P, Becerra A, et al. Ultrasound-guided injection of polidocanol microfoam in the management of venous leg ulcers. *Arch Dermatol* 2004; 140: 667–673.
2. Bradbury AW, Brittenden J, Allan PL, et al. Comparison of venous reflux in the affected and non-affected leg in patients with unilateral venous ulceration. *Br J Surg* 1996; 83: 513–515.
3. Allan PL. Role of ultrasound in the assessment of chronic venous insufficiency. *Ultrasound Q* 2001; 17: 3–10.
4. Barwell JR, Davies CE, Deacon J, et al. Comparison of surgery and compression with compression alone in chronic venous ulceration (ESCHAR study): randomised controlled trial. *Lancet* 2004; 363: 1854–1859.
5. Gohel MS, Barwell JR, Taylor M, et al. Long term results of compression therapy alone versus compression plus surgery in chronic venous ulceration (ESCHAR): randomised controlled trial. *BMJ* 2007; 335: 83.
6. Rasmussen LH, Lawaetz M, Bjoern L, et al. Randomized clinical trial comparing endovenous laser ablation, radiofrequency ablation, foam sclerotherapy and surgical stripping for great saphenous varicose veins. *Br J Surg* 2011; 98: 1079–1087.
7. Shadid N, Ceulen R, Nelemans P, et al. Randomised clinical trial of ultrasound-guided foam sclerotherapy versus surgery for the incompetent great saphenous vein. *Br J Surg* 2012; 99: 1062–1070.
8. NICE guidelines CG168. Varicose veins in the legs, July 2013.
9. Brittenden J, Cotton SC, Elders A, et al. A randomised trial comparing treatments for varicose veins. *N Engl J Med* 2014; 371: 1218–1227.
10. Darke SG and Baker S. Ultrasound-guided foam sclerotherapy for the treatment of varicose veins. *Br J Surg* 2006; 93: 969–974.
11. Pang KH, Bate GR, Darvall KAL, et al. Healing and recurrence rates following ultrasound-guided foam sclerotherapy of superficial venous reflux in patients with chronic venous ulceration. *Eur J Vasc Endovasc Surg* 2010; 40: 790–795.
12. Bradbury AW, Bate G, Pang K, et al. Ultrasound-guided foam sclerotherapy is a safe and clinically effective treatment for superficial venous reflux. *J Vasc Surg* 2010; 52: 939–945.
13. Chapman-Smith P and Browne A. Prospective five-year study of ultrasound-guided foam sclerotherapy in the treatment of great saphenous vein reflux. *Phlebology* 2009; 24: 183–188.
14. Cavezzi A, Frullini A, Ricci S, et al. Treatment of varicose veins by foam sclerotherapy: two clinical series. *Phlebology* 2002; 17: 13–18.
15. Wright D, Gobin JP, Bradbury AW, et al. Varisolve ® polidocanol microfoam compared with surgery or sclerotherapy in the management of varicose veins in the presence of trunk vein incompetence: European randomised controlled trial. *Phlebology* 2006; 21: 180–190.
16. Ouvry P, Desnos P and Hamel-Desnos C. Efficacy of polidocanol foam versus liquid in sclerotherapy of the great saphenous vein: a multicentre randomised controlled trial with a 2-year follow up. *Eur J Vasc Endovasc Surg* 2008; 36: 366–370.
17. Darvall KAL, Bate GR, Adam DJ, et al. Duplex ultrasound outcomes following ultrasound-guided foam sclerotherapy of symptomatic recurrent great saphenous varicose veins. *Eur J Vasc Endovasc Surg* 2011; 42: 107–114.
18. Kulkarni SR, Slim FJA, Emerson LG, et al. Effect of foam sclerotherapy on healing and long term recurrence

in chronic venous leg ulcers. *Phlebology* 2013; 28: 140–146.
19. Tessari L. Nouvelle technique d'odtention de la sclero-mousse. *Phlebology* 2000; 53: 129.
20. Kulkarni SR, Messenger DE, Slim FJA, et al. The incidence and characterization of deep vein thrombosis following ultrasound-guided foam sclerotherapy in 1000 legs with superficial venous reflux. *J Vasc Surg* 2013; 1: 231–238.
21. Smith CP. Chronic venous disease treated by ultrasound guided foam sclerotherapy. *Eur J Vasc Endovasc Surg* 2006; 32: 577–583.
22. Barwell JR, Ghauri ASK, Taylor M, et al. Risk factors for healing and recurrence of chronic leg venous ulcers. *Phlebology* 2000; 15: 49–52.
23. Kulkarni SR, Barwell JR, Gohel MS, et al. Residual venous reflux after superficial venous surgery does not predict ulcer recurrence. *Eur J Vasc Endovasc Surg* 2007; 34: 107–111.
24. Guest M, Smith JJ, Sira MS, et al. Venous ulcer healing by four-layer compression bandaging is not influenced by the pattern of venous incompetence. *Br J Surg* 1999; 86: 1437–1440.