Original Article

Phlebology

Phlebology
0(0) 1–11

DOI: 10.1177/0268355519885221
journals.sagepub.com/home/phl
SAGE

A randomised controlled trial of perivenous tumescent anaesthesia in addition to general anaesthesia for surgical ligation and stripping of the great saphenous vein

Sandip Nandhra, Tom Wallace, Joseph El-Sheikha, Daniel Carradice and Ian Chetter

Abstract

Introduction: Open surgical ligation and stripping of the great saphenous vein is a highly cost-effective treatment when compared with conservative management and foam sclerotherapy but has limitations including post-operative morbidity and pain. This study aims to identify if the addition of tumescent anaesthesia could improve patient outcomes following treatment.

Methods: Patients with primary superficial venous incompetence undergoing open surgical ligation and stripping of the great saphenous vein were randomised to either General Anaesthesia (GA) alone (GA) procedure or the addition of tumescent (G + T). The primary outcome was bodily pain (within SF-36) at one week. Additional outcomes included post-procedural pain score (100 mm visual analogue scale), complications and quality of life.

Results: A total of 90 patients were randomised for inclusion. There was no significant difference in primary outcome; bodily pain at one week. Secondary outcome of 4-h post-procedural scores were significantly lower in the G + T group (32 (20–54) mm vs. (GA alone) 56 (24–70) mm ($P = 0.016$)). Complications were minor and equivalent. Both groups saw a significant increase (worsening) in Aberdeen Varicose Vein Questionnaire scores at week 1 with the G + T group faring worse at six weeks (10.0 (Interquartile Range [IQR] 5.6–17.9) vs. 4.3 (IQR 2.7–7.9) $P = 0.004$).

Conclusion: The G + T group did not demonstrate a significant difference in the one-week bodily pain domain. The addition of tumescent anaesthesia does improve immediate post-operative pain but appears to negatively impact on six-week quality of life.

EudraCT Number: 2011-005574-39

Keywords

Venous reflux, vein stripping, great saphenous vein, ligation

Introduction

Superficial venous incompetence (SVI) involving the saphenofemoral junction (SFJ) and great saphenous vein (GSV) is involved in 80% of varicose veins.[1] Open surgical ligation and stripping ('high-tie and stripping') of the GSV for SVI is still performed and is recommended as a third-tier intervention within the NICE guideline (CG168). Surgery is a cost-effective treatment when compared with conservative management and foam sclerotherapy[2] but has limitations including post-operative morbidity and pain. Patient satisfaction with surgery is low, with an initial reduction in quality of life (QoL) relating to pain and physical disability in the immediate post-procedural period. This is sufficient to delay a return to normal

Academic Vascular Surgery, Hull Royal Infirmary, Hull, UK

Corresponding author:
S Nandhra, Hull York Medical School, 1st Floor, Hull Royal Infirmary, Hull, East Yorkshire HU12JZ, UK.
Email: sjnandhra@gmail.com

activities of daily and employment.[3] Endothermal ablation using perivenous tumescent anaesthesia has been demonstrated to be as efficacious and effective as surgery in the long term, but with significantly less pain and disability initially. One aspect hypothesised to cause increased morbidity following 'high-tie and stripping' is the greater pain experienced in the immediate aftermath. A method to optimise post-operative pain could be to consider the application of tumescent anaesthesia, borrowed from endovenous procedures, to identify if this provides an enhanced patient reported experience. A previous study reported outcomes of both surgical and endovenous procedures under local anaesthesia, whilst possible and tolerable, the study however found that one week reported pain was higher in the endovenous group compared to the surgical group.[4] This contradicts an Randomised Control Trial (RCT) performed previously comparing surgery to endovenous ablation.[5]

The aim of this study, therefore, is to evaluate the use of perivenous local anaesthesia during open SFJ ligation and GSV stripping under general anaesthetic to ascertain if this procedural refinement offers improvements in patient reported pain, QoL and recovery to normal activities.

Methods

This single-blind randomised clinical trial was approved by: the National Research ethic committee for a clinical trials of an investigational medicinal product (CTMP), local institutional research and development department and the Medicines for Health Regulation Agency (MHRA) and registered on the European Union Clinical Trials Register (EudraCT 2011-005574-39).

Patients presenting to the vascular surgical department between October 2012 and June 2014 were assessed for trial participation.

Inclusion criteria included adults with primary symptomatic SVI, CEAP grades C2–C6, suitable to undergo open surgical ligation and GSV stripping on Duplex ultrasound (DUS) assessment. Incompetence was defined as reflux of at least 0.5 s on spectral Doppler analysis. Prior to the introduction of the UK NICE guidance CG168, patients were offered the intervention either endothermal ablation or surgery and thereafter invited to participate in the study. Subsequent to July 2013, participants were offered surgery at surgeon or patient preference in a non-trialist clinic, where the anatomy was not favourable for endovenous procedure or guided by patient choice and past experience. Participants were excluded if an alternative axis of incompetence was identified, treatment was not deemed technically feasible, they were unwilling or unable to participate in the study or follow-up, had previous deep venous thrombosis or chronic occlusion, active or recent superficial vein thrombosis (within the last six weeks), previous ipsilateral varicose vein treatment or known peripheral arterial disease (impalpable foot pulses, or ankle-brachial pressure index less than 0.8.

Patients were seen in a dedicated one-stop venous clinic where they were assessed and underwent a detailed clinical and DUS assessment according to UIP consensus guidelines,[6] which specify a complete assessment of the deep and superficial venous system. DUS examinations were performed by individuals with a formal postgraduate vascular ultrasound qualification. Once eligibility was confirmed, they were invited to participate and to provide written informed consent.

Patients were randomised by an online digital randomisation programme (www.sealedenvelope.com) after invitation to participate and prior to the procedure. The outcome of the randomisation was concealed from the participant. Patients were randomised to either a standard open surgical procedure under General Anaesthesia (GA) (GA Group) or to the addition of tumescent (G + T group) once they had been listed for surgical management.

Surgery was performed as a day-case outpatient as per the standard practice in our unit. Patients were risk-assessed for venous thromboembolism using a standard proforma widely utilised in UK NHS practice[7] and those deemed to be at high risk received a single pre-procedural prophylactic dose of subcutaneous low-molecular weight heparin. The operating surgeon undertaking the procedure did so as per usual practice, independent of the trial team, performing the clinical assessment, marking of varicosities and undertaking the procedure. They were not involved in the trial documentation or review.

Following induction of general anaesthesia, the patient was positioned on the operating table and underwent sterilisation and draping of the leg. The SFJ was divided and ligated in standard fashion via a groin incision. All tributaries were identified and ligated back to second generation tributaries wherever possible. A PIN stripper was then advanced down the GSV to emerge at, or just below, the level of the knee.

At this stage, those randomised to the addition of tumescent, G + T, received perivenous tumescent anaesthesia under DUS guidance. The solution was made up of 900 ml of 0.9% sodium chloride solution with 100 ml of 1% lidocaine with 1:200,000 epinephrine added. Each bag of tumescent anaesthesia was for single-use only. The anaesthesia was administered using a pedal-operated peristaltic pump (Nouvag DP-20, Nouvag, Goldach, Switzerland) along the GSV (with PIN stripper in situ) with the use of DUS guidance, at a target of

10 ml per cm. Tumescent anaesthesia was also infiltrated into the groin incision and around all tributaries and perforators to be treated, this was performed by the operating surgeon, competent in DUS and endovenous ablative techniques. Patients in the control group received local anaesthesia consisting of 1% lidocaine with 1:200,000 epinephrine to the groin incision and stripper exit site only as per standard practice.

Both groups then underwent inversion stripping of the GSV, followed by ambulatory phlebectomy of the pre-marked varicose tributaries through stab incisions. The cribriform fascia was closed followed by the groin incision in two-layers using an absorbable suture. All phlebectomy sites were dressed with Steri-Strips™ (3M UK PLC, Bracknell, UK), cotton wool and gauze and an elasticated compression bandage applied from foot to groin. Patients with C6 disease received four-layer compression bandaging. All patients were provided with a one-week supply of paracetamol 1 g Qater die Sumendum (QDS) / four times daily and diclofenac 50 mg Ter die Sumendum (TDS) / three times daily, unless contraindicated.

Primary outcome

The primary outcome was the bodily pain (BP) domain of SF-36 QoL tool at one week.

Secondary outcome measures

These include 4–6 h post-operative pain on a 100 mm visual analogue scale (VAS, 0 = no pain, 100 = worst pain imaginable), daily average pain scores on 100 mm VAS and daily analgesia use for the first week, technical success, complications, recovery, QoL and patient satisfaction at 12 weeks.

Technical success was defined as an absence of intact groin tributaries and GSV in the thigh on DUS. Complications were recorded in accordance with Clavien-Dindo Classification of surgical complications.[8] Disease specific QoL was assessed using the Aberdeen Varicose Vein Questionnaire (AVVQ[9,10]) which records the specific impact of venous disease on QoL. Generic QoL was assessed by two instruments: the SF-36 UK V1[11,12] and EuroQol 5D.[13] The SF-36 tool assesses 36 items to derive eight domains, each scored from 0 (worst possible) to 100 (best possible). The domains assessed are physical function, role limitation due to physical disability, BP (primary outcome), general health, vitality, social function, role limitation due to emotional problems and mental health. The EuroQol (EQ5D™; EuroQol Group, Rotterdam, The Netherlands) assesses five domains. Both instruments have been proven to be valid and reliable in the context of venous disease and treatment.[10,14,15]

Sample size

A previous study[3] revealed that at one week post-operatively, patients undergoing EVLA had a 12-point lower median score in the BP domain of the SF-36 (score of 74 (54–84)), compared to patients undergoing conventional surgery (score of 62 (41–74)). If the use of tumescent anaesthesia accounts for this difference, then given an alpha of 0.05, power of 80% and attrition of 15%, 43 patients in each arm are required to see this effect.

Statistical analysis

Data were recorded in a dedicated database (Microsoft Access; Microsoft, Redmond, Washington, USA). Normally distributed data are presented as mean (SD), and hypothesis testing performed with paired and unpaired t-tests. Non-normally distributed data are presented as median (Interquartile Range [IQR]) values with analysis using Mann–Whitney U test for unrelated samples and Wilcoxon signed rank test (WSR) for paired data. Friedman test was used to analyse multiple related samples across the study interval. Categorical data were analysed by means of chi squared (χ^2) or, if necessary, Fisher's exact test. Analysis was by the principle of intention to treat. All data were collected during the dedicated clinic follow-up. Statistical analysis was performed using SPSS version 20 (SPSS, IBM, Chicago, Illinois, USA). A p value of <0.050 was considered statistically significant for single comparisons; Bonferroni correction was performed for multiple intragroup comparisons of QoL measures over time, with the adjusted alpha level reported.

Results

A total of 122 patients were screened. A total of 90 patients were randomised for inclusion. Twenty-two participants were excluded; seven declined to participate, the remaining 15 had bilateral disease or a non-GSV axis incompetence. A CONSORT diagram is shown in Figure 1. Baseline demographics and disease severity were comparable (see Table 1).

All procedures were completed successfully with no difference in the operative time (see Table 2).

Primary outcome

For SF-36 BP at one week, there was no significant difference between the groups (see Figure 2).

Secondary outcomes

Pain. The post-operative pain scores (4–6 h post procedure) were significantly lower in the interventional

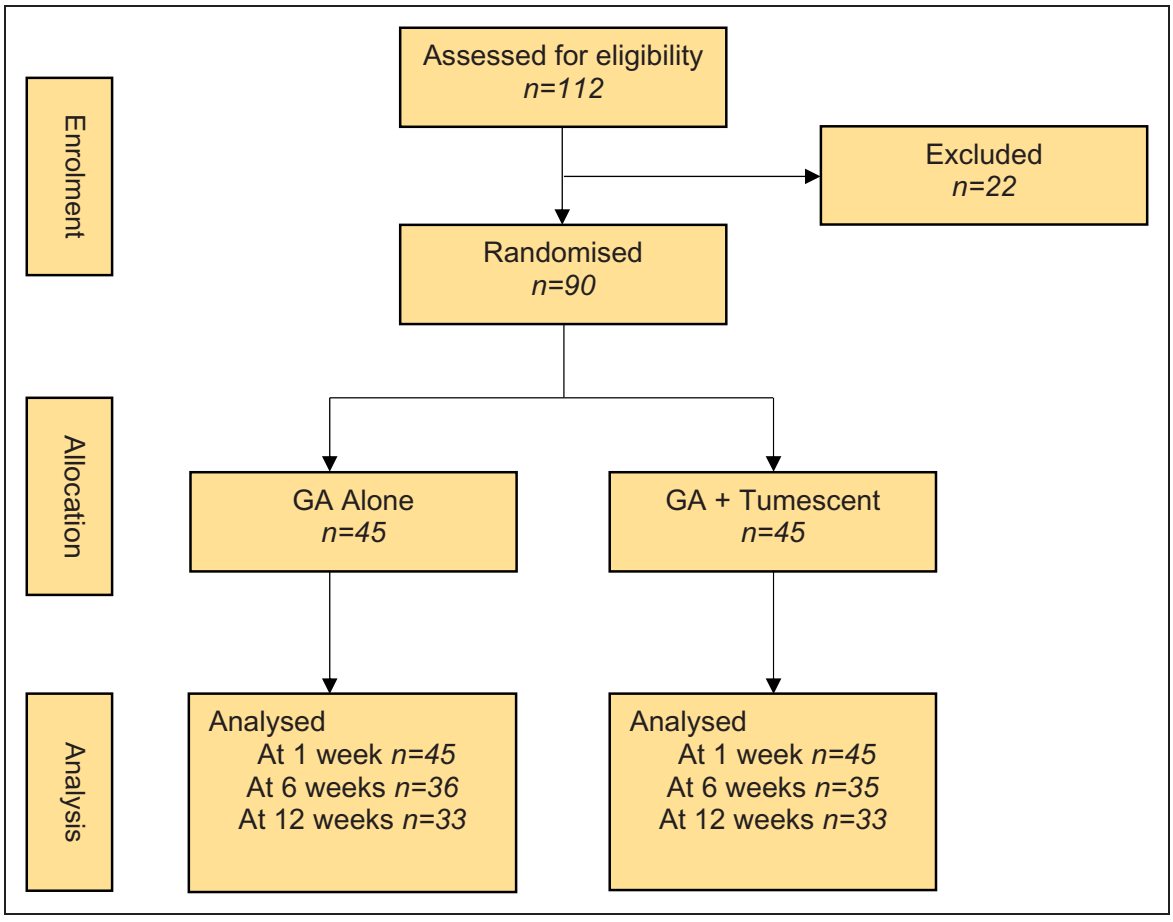

Figure 1. CONSORT diagram.

group (G + T); 32 (20–54) mm compared to the control (GA alone) group of 56 (24–70) mm (P = 0.016) (see Figure 3). Analgesia use was equivalent between the groups (see Table 3).

Recovery. There were no differences in recovery time between the two groups. Median time to return to normal activity in the G + T group was 7 (3–14) vs. 6 (2–7) days (P = 0.153).

Both groups saw a significant decrease (improvement) in - Venous Clinical Severity Score (VCSS) scores from baseline to 12 weeks. The GA group improving from 9 (6–11) to 0 (0–1) and the GA tumescent group decreasing from 8 (5–10) to 0 (0–1) (WSR, P = 0.000). There were no differences between either group at 12 weeks (P = 0.712).

Complications. There were no significant differences between the groups for any complications. Two episodes of superficial vein thrombosis in each group were noted. A single patient sought medical attention after discharge for bleeding through the dressings in the control GA alone group. There was one episode of groin wound infection (superficial) in the G + T group which required a five-day course of oral antibiotics. Sensory disturbance was noted in two instances in each group, this was limited to cutaneous nerve involvement of the medial thigh. This did not recover by the end of the 12-week follow-up. There were no episodes of venous thromboembolism or allergy recorded.

Technical success. There was a high and equivalent rate of technical success with an absence of the GSV detected in all participants across both groups.

Quality of life. Both groups saw a significant increase (worsening) in AVVQ scores at week 1 but then a significant decrease (improvement) from baseline at week 12 (WSR, P < 0.050). In both groups, BP, general health, vitality and role limitation due to emotional issues decreased (worsened) significantly from baseline to week 1, but then increased (improved) from baseline in physical functioning (WSR, P < 0.001 and P = 0.006), BP (P < 0.001), general health (P = 0.001 and 0.047), vitality (P = 0004 and 0.010), social function (P < 0.001 and P = 0.011) and mental health

Table 1. Baseline characteristics.

	GA alone	GA + tumescent	P
Age Mean (S.D)	50.9 (15.7)	48.5 (14.8)	0.067
Gender	28F:17M	29F:16M	0.834
	62%F	64%F	
Height (cm)	164.2 (0.12)	151.8 (0.41)	0.681
Weight (kg)	78.8 (13.1)	90.2 (27.1)	0.142
Antiplatelet/anticoagulant	13 %	11%	0.668
Diameter GSV			
Groin (cm)	7.1 (5.4–8.4)	8.3 (6.5–10.1)	0.089
Knee (cm)	5.2 (4.5–6.2)	4.8 (3.9–6.0)	0.160
VCSS	9 (6–11)	8 (5–10)	0.252
CEAP			
C2	21 (47%)	23 (51%)	0.675
C3–C6	24 (53%)	22 (49%)	0.834
AVVQ Median (IQR)	13.6 (9.5–19.2)	16.2 (10.7–24.4)	0.131
SF-36 domains Median (IQR)			
Physical function	90 (85–100)	90 (65–95)	0.067
Role-physical	100 (75–100)	100 (75–100)	0.446
Bodily pain	64 (51–84)	62 (41–74)	0.078
General health	77 (72–87)	72 (60–82)	0.069
Vitality	70 (55–80)	60 (45–75)	0.083
Social function	50 (50–75)	50 (50–75)	0.627
Role-emotional	100 (100–100)	100 (100–100)	0.259
Mental health	76 (68–88)	76 (56–88)	0.554
Euroqol 5 domain index	0.877 (0.806–1.000)	0.796 (0.770–0.919)	0.61

GSV: great saphenous vein; AVVQ: Aberdeen Varicose Vein Questionnaire; CEAP: Clinical-Aetiological-Anatomical-Pathophysiological.

Table 2. Procedural outcomes.

	GA alone	GA + tumescent	P
Length of vein stripped (cm)	35 (8.7)	36.9 (10.1)	0.647
Completion of procedure	100%	100%	N/A
Operative time (minutes)	63 (55–75)	63 (54–80)	0.824

($P = 0.001$). There was a significant decrease (worsening) in EQ5D scores at week 1 in both groups and again an increase (improvement) by week 12 (see Table 4).

On intergroup comparison there was a significantly higher (worse) AVVQ score in the G + T group at week 6 (10.0 (IQR 5.6–17.9) vs. 4.3 (IQR 2.7–7.9) $P = 0.004$) (see Figure 4). In addition to the BP domain there were inter-group differences detected in other domains of SF-36. There was a significantly worse (lower) BP score at six weeks (73 vs. 84 $P = 0.007$) in the G + T group compared to GA alone. This difference did not persist (see Table 4).

There were significantly lower (worse) physical function scores in the G + T group at week 6 (95 (85–100) vs.100 (95–100) $P = 0.006$) and week 12 (95 (80–100) vs. GA alone 100 (95–100) $P = 0.045$) (see Table 4). There were no detectable differences in the EQ5D scores between the groups at any time points. Both groups reported equally high satisfaction with the cosmetic result and the treatment modality overall (see Figure 5).

Discussion

This single blind randomised clinical trial has demonstrated that tumescent anaesthesia infiltration prior to GSV stripping is feasible but that the addition of tumescent anaesthesia to general anaesthesia (G + T) group did not translate into any benefit in terms of QoL, analgesia use or recovery times; therefore, the null hypothesis stands.

SFJ ligation and stripping under GA was confirmed to be a safe, efficacious and effective treatment for SVI, improving objective clinical severity, disease specific and generic QoL. Satisfaction rates for both groups in this study were very high.

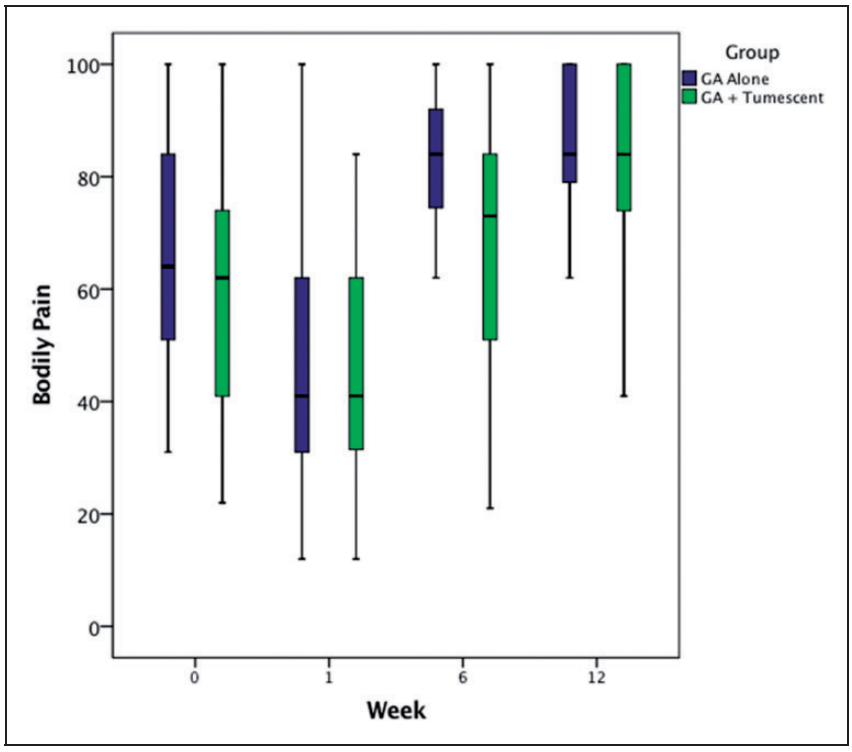

Figure 2. Bodily pain domain, over time, by group.

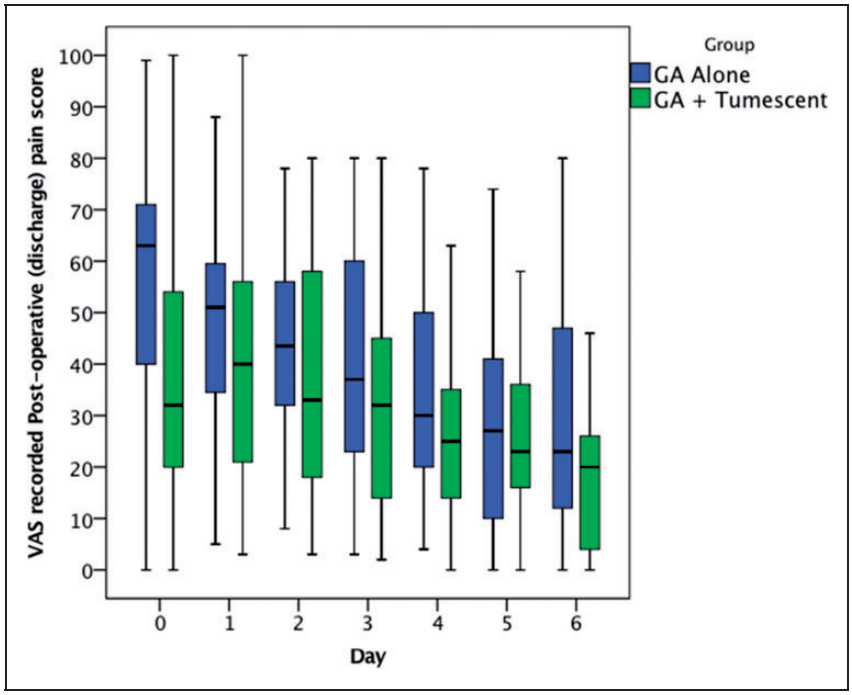

Figure 3. Post-procedural pain scores from day of procedure (day 0) to day 6.

One significant finding as part of the secondary outcomes was that the addition of tumescent anaesthesia did lead to a significant reduction in 4–6 h post-operative pain on 100 mm VAS with scores of 32 (20–54) compared to 56 (24–70) mm ($P = 0.016$). These findings are unique as there are not any directly comparable studies in the literature for this method of tumescent application under GA. Unfortunately,

Table 3. Percentage of analgesic (paracetamol and NSAID) consumption by participants, by group, over the first six days.

Day	GA alone (%)	GA + tumescent (%)	P
Paracetamol			
0	60.0	63.2	0.365
1	52.5	57.8	0.634
2	45.0	55.3	0.368
3	32.5	42.1	0.383
4	35.0	42.1	0.522
5	30.0	39.5	0.382
6	25.0	26.1	0.907
NSAID			
0	50.0	55.2	0.420
1	47.5	39.5	0.478
2	35.0	31.6	0.750
3	30.0	21.1	0.369
4	25.0	13.2	0.188
5	22.5	18.4	0.658
6	20.0	8.0	0.152

studies involving surgery for both the GSV[5] and SSV[16,17] have shown comparable post-procedural scores to this study but the focus of these studies in terms of primary outcome was not pain as such. It maybe that there was an element of reporting bias by the participant given that the study was primarily designed to assess pain and BP. Although unique in its application of tumescent in addition to GA at the point of striping, the addition of large volume anaesthesia has been described in a similar context. Nisar et al.[18] conducted an RCT with addition of a local anaesthetic 'flush' delivered by means of a fine bore nasogastric feeding tube to the strip tract after GSV stripping which reported a significant reduction in immediate post-procedural pain (median of 1 compared to 4 in the control group). The findings in the RCT presented are comparable to these results.[18]

An alternative study conducted at this institution was powered to detect a clinically significant difference of 13 mm[19] and required 43 participants to observe an effect of at least this magnitude. In this study at week 1, 45 participants in each group attended with completed pain scores.[20] This is therefore likely to be a true representation of the pain scores and the detected differences. This is also confirmed by a post-hoc power analysis.

Lidocaine is reported to have an activity for between 30 min and 2 h but in this study, benefits were seen at 4–6 h. The mechanism is explained by the fact that tumescent anaesthesia is delivered within the saphenous sheath and remains in the area of infiltration which delays systemic uptake and metabolism of lidocaine prolonging the local action.[21,22] Furthermore, the tumescent was combined with epinephrine (1:2,000,000) which acts a potent vasoconstrictor, thus reducing the uptake and dissipation of the active lidocaine agent; evidence suggests that peak plasma concentration is in the region of 8 to 12 h.[23,24]

The G + T groups received tumescence to all wounds including the phlebectomy sites, the additional volume in the dermis here creates a *peu d'orange* appearance of the skin as the fluid is compartmentalised and has been shown to significantly reduce the systemic absorption rate of lidocaine,[25] therefore supporting the rationale that the addition of tumescent reduced post-operative pain in the recovery time frame of 4–6 h.

The procedures being performed under GA controls for variables such as the environment, the presence of music, familiarity of the theatre personnel with the patient and the procedure and lack of technical jargon. Each of these factors have been shown to influence pain outcomes for patients.[26–29] The scores were recorded in the day case recovery area and here the environment is standardised.

As mentioned previously, tumescence anaesthesia alone has been used to perform both open and endovenous ablation of the GSV.[4] This study found the pain outcome to be superior in the surgical group compared to the endovenous group. Whilst not a direct comparison, the findings provide an interesting comparison.

Several aspects of QoL were actually worse in the group receiving tumescent anaesthesia; these included SF-36 BP at six weeks, SF-36 physical function at 6 and 12 weeks and finally AVVQ at six weeks. These should be considered with caution as at week 6 there was a high trial drop out. Similarly, potential baseline mismatch is a culprit as there was trend towards this in the baseline characteristics. There was, however, a similar improvement from baseline and a treatment-related short-term deterioration as seen in other studies.[5] Similarly, disease specific QoL analysis detected a difference at week 6 again; there were 35 and 36 participants in each group. To detect differences in the AVVQ it is postulated that much larger number of participants would be required.

The length of veins stripped was equivalent between the groups (38 vs. 40 cm); the method of stripping using a standardised PIN stripper may have pre-determined the strip length by how far it could be advanced; therefore, the significance of these results is limited.

Neither group suffered a major complication, although a minor complication of wound infection was seen in the interventional group and therefore is unable to support or refute existing evidence of a tumescence sanitising effect.[30]

Table 4. Generic health-related QoL outcomes, by group, over time.

	Week	GA alone	GA + tumescent	P
SF-36				
Physical function	0	90 (85–100)	90 (65–95)	0.067
	1	75 (50–90)	60 (40–85)	0.173
	6	100 (95–100)	95 (85–100)	**0.006**
	12	100 (95–100)	95 (80–100)	**0.045**
Role-physical	0	100 (75–100)	100 (75–100)	0.446
	1	88 (0–100)	25 (0–100)	0.448
	6	100 (100–100)	100 (75–100)	0.264
	12	100 (100–100)	100 (75–100)	0.178
Bodily pain	0	64 (51–84))	62 (41–72)	0.078
	1	41 (31–62)	41 (31–62)	0.851
	6	84 (74–100)	73 (51–84)	***0.007***
	12	84 (79–100)	84 (74–100)	0.377
General health	0	77 (72–87)	72 (60–82)	0.069
	1	82 (67–95)	72 (62–82)	0.128
	6	87 (77–97)	77 (72–87)	0.026
	12	87 (77–97)	77 (67–90)	0.027
Vitality	0	70 (55–80)	60 (45–75)	0.083
	1	60 (35–80)	65 (45–80)	0.726
	6	80 (50–85)	65 (50–80)	0.234
	12	80 (75–88)	80 (65–85)	0.243
Social function	0	50 (50–75)	50 (50–75)	0.627
	1	50 (50–75)	50 (50–63)	0.377
	6	63 (50–100)	50 (50–88)	0.171
	12	100 (56–100)	63 (50–100)	***0.044***
Role-emotional	0	100 (100–100)	100 (100–100)	0.259
	1	100 (34–100)	100 (0–100)	0.534
	6	100 (100–100)	100 (100–100)	0.796
	12	100 (100–100)	100 (100–100)	0.795
Mental health	0	76 (68–88)	76 (56–88)	0.554
	1	80 (68–92)	82 (60–92)	0.929
	6	92 (68–92)	88 (72–92)	0.745
	12	92 (84–92)	90 (80–92)	0.413
EQ5D	0	0.877 (0.806–1.000)	0.796 (0.770–0.919)	0.061
	1	0.760 (668–0.772)	0.772 (0.691–0.841)	0.387
	6	1.000 (0.877–1.000)	1.000 (0.841–1.000)	0.346
	12	0.877 (0.877–1.000)	1.000 (0.796–1.000)	0.142

Note: Bold and italics signifies $P < 0.05$.

The extent of ambulatory phlebectomy could not be controlled pre-operative and was not recorded. This is a limitation within this study. Notably, all visible, symptomatic varicosities were marked by non-trialist clinicians preoperatively with the patient standing and providing their input. Thus, there is potential for phlebectomy to act as a confounder for any or post-operative pain, patient satisfaction and QoL. However, all included patients were taken from routine NHS referrals without bias and so there is no significant concern that the treatment groups were not representative of typical practice. Given that all participants blinded and that the surgeons performing the procedure were not conducting the randomisation or involved in the study process, it is unlikely that there was a bias in one group or the other. Ultimately, there is no significant concern about the integrity of the results based upon the extent of phlebectomies across both studies and the extrapolation to the wider NHS practice.

The duration of post-procedural (TED stocking) compression in this study was longer (six weeks) than reported in many other studies and that recommended by the most recent NICE guidance,[31] which recommends that compression is worn for one-week post procedure. The clinical effect of this on outcome is unknown but both groups received the same duration of compression. It is noted that this may or may not be a confounding factor in the study.

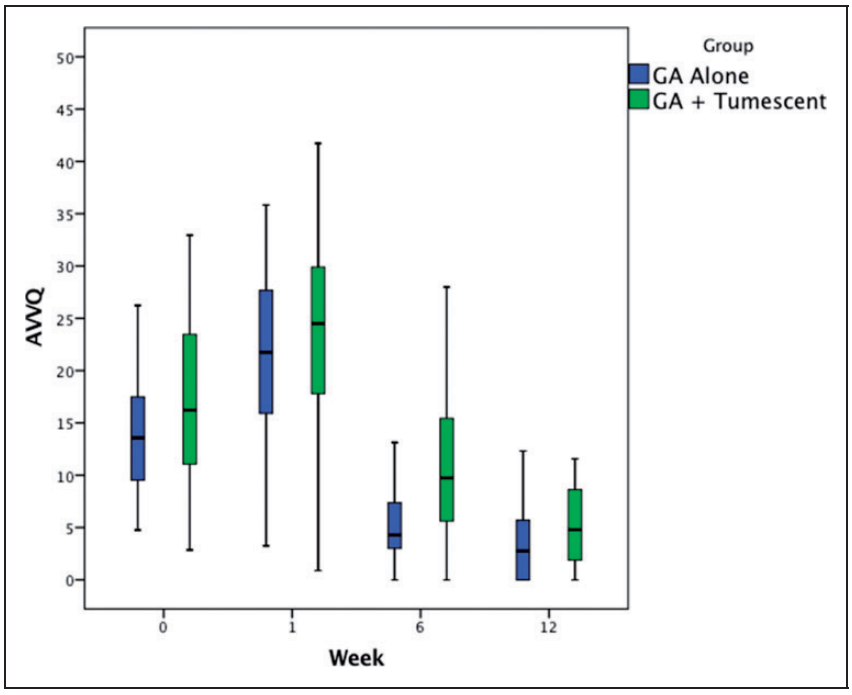

Figure 4. Disease specific quality of life impairment (AVVQ), over time, by group.

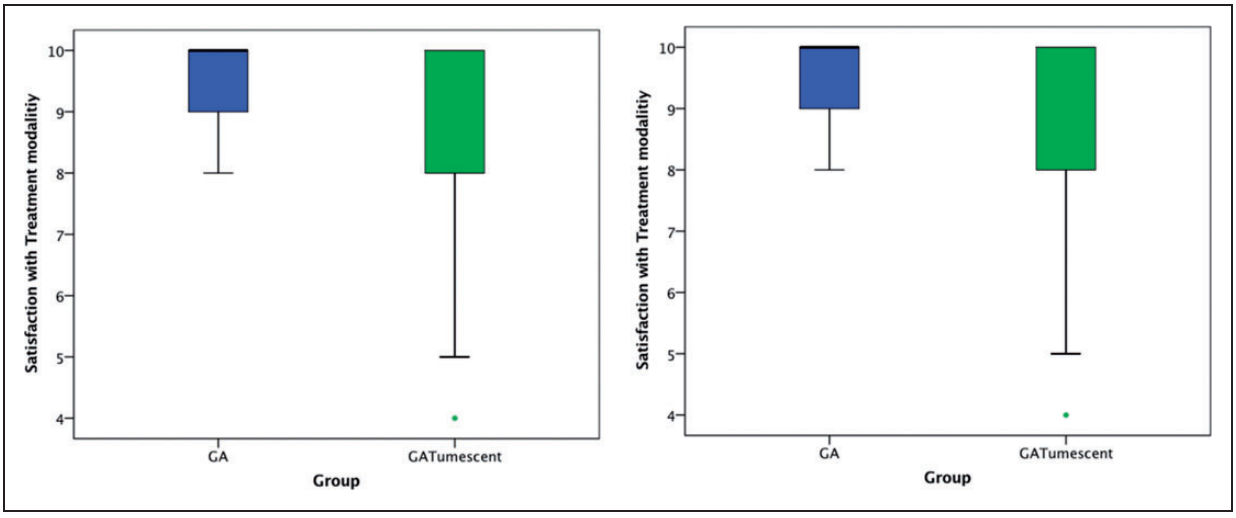

Figure 5. Twelve-week patient satisfaction with treatment (left) and cosmetic outcome (right).

Patient satisfaction levels at 12 weeks were high in both groups. Those who did not return at 12 weeks were assumed to be satisfied as opposed to dissatisfied given that the procedure was invasive. Historically, previous study experience within the two-year and five-year follow-ups for HELP, and one-year and two-year follow-ups for the SSV axis found that those who did not attend DNA and were contacted by telephone had a high satisfaction and none felt the need for additional clinical review, as they were satisfied with the treatment.

Conclusion

The addition of peri-venous tumescent to general anaesthesia did not impact on one-week QoL BP scores as per the primary outcome. There was however an improvement in 4-h post-operative pain scores. Given the limitations and the negative primary outcome, a clear benefit of the addition of tumescent has not been identified. Furthermore, there were adverse consequences in terms of interim-QoL. But at the end

of the study, the surgical treatment of SVI results in equivalent benefits in patient reported outcome measures (PROM). Centres world-wide are still providing open surgical ligation and stripping as the treatment of choice and given the evidence on efficacy, QoL improvements and cost effectiveness, this is not entirely unreasonable.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was funded by the University of Hull and the Hull-York Medical School.

Ethical approval

The ethics committee of East Yorkshire approved this study. The study was subject to MHRA approval and monitoring under the Medicines for Human Use (Clinical Trials) Regulations 2004 and Amendment Regulations 2006 and subsequent amendments; the International Conference for Harmonisation of Good Clinical Practice (ICH GCP) guidelines; and the Research Governance Framework for Health and Social Care.

Contributorship

SN – Involved in ethical approval, executed protocol complied with MHRA assessment and monitoring, recruitment; led analysis, write-up and submission. TW – Researched literature, registered and gained ethical approval, assisted in write-up and submission. JEl-S – Patient recruitment, data submission and write-up review. DC – Review of manuscript, technical and trial design input, pre-submission manuscript review. IC – Overall senior academic and lead for trial; consulted throughout trial development, execution and write-up. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

Acknowledgements

We would like to thank Josie Hatfield for her assistance and guidance in this research.

Guarantor

IC.

ORCID iD

Sandip Nandhra https://orcid.org/0000-0002-6036-5760

References

1. Khilnani NM, Grassi CJ, Kundu S, et al. Multi-society consensus quality improvement guidelines for the treatment of lower-extremity superficial venous insufficiency with endovenous thermal ablation from the Society of Interventional Radiology, Cardiovascular Interventional Radiological Society of Europe, American College of Phlebology and Canadian Interventional Radiology Association. *J Vasc Interv Radiol* 2010; 21: 14–31.
2. Tassie E, Scotland G, Brittenden J, et al. Cost-effectiveness of ultrasound-guided foam sclerotherapy, endovenous laser ablation or surgery as treatment for primary varicose veins from the randomized CLASS trial. *Br J Surg* 2014; 101: 1532–1540.
3. Carradice D, Mekako AI, Mazari FA, et al. Randomized clinical trial of endovenous laser ablation compared with conventional surgery for great saphenous varicose veins. *Br J Surg* 2011; 98: 501–510.
4. Pronk P, Gauw SA, Mooij MC, et al. Randomised controlled trial comparing sapheno-femoral ligation and stripping of the great saphenous vein with endovenous laser ablation (980 nm) using local tumescent anaesthesia: one year results. *Eur J Vasc Endovasc Surg* 2010; 40: 649–656.
5. Carradice D, Mekako AI, Mazari FA, et al. Randomized clinical trial of endovenous laser ablation compared with conventional surgery for great saphenous varicose veins. *Br J Surg* 2011; 98: 501–510.
6. De Maeseneer M, Pichot O, Cavezzi A, et al. Duplex ultrasound investigation of the veins of the lower limbs after treatment for varicose veins – UIP consensus document. *Eur J Vasc Endovasc Surg* 2011; 42: 89–102.
7. National Institute for Health and Care Excellence. Venous thromboembolism: reducing the risk for patients in hospital (Clinical guideline CG92), https://www.nice.org.uk/guidance/cg92 (2010, accessed 6 September 2019).
8. Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien–Dindo classification of surgical complications: five-year experience. *Ann Surg* 2009; 250: 187–196.
9. Garratt AM, Macdonald LM, Ruta DA, et al. Towards measurement of outcome for patients with varicose veins. *Qual Health Care* 1993; 2: 5–10.
10. Garratt AM, Ruta DA, Abdalla MI, et al. Responsiveness of the SF-36 and a condition-specific measure of health for patients with varicose veins. *Qual Life Res* 1996; 5: 223–234.
11. Ware JE. *SF-36 health survey: manual and interpretation guide*. Boston, MA: New England Medical Center, Health Institute, 1993.
12. Ware JE Jr and Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992; 30: 473–483.
13. The EuroQol Group. EuroQol – a new facility for the measurement of health-related quality of life. *Health Policy* 1990; 16: 199–208.
14. Brazier J, Jones N and Kind P. Testing the validity of the Euroqol and comparing it with the SF-36 health survey questionnaire. *Qual Life Res* 1993; 2: 169–180.

15. Hartung O. Embolization is essential in the treatment of leg varicosities due to pelvic venous insufficiency. *Phlebology* 2015; 30: 81–85.
16. Samuel N, Carradice D, Wallace T, et al. Randomized clinical trial of endovenous laser ablation versus conventional surgery for small saphenous varicose veins. *Ann Surg* 2013; 257: 419–426.
17. Nandhra S, El-sheikha J, Carradice D, et al. A randomized clinical trial of endovenous laser ablation versus conventional surgery for small saphenous varicose veins. *J Vasc Surg* 2015; 61: 741–746.
18. Nisar A, Shabbir J, Tubassam MA, et al. Local anaesthetic flush reduces postoperative pain and haematoma formation after great saphenous vein stripping – a randomised controlled trial. *Eur J Vasc Endovasc Surg* 2006; 31: 325–331.
19. Todd KH, Funk KG, Funk JP, et al. Clinical significance of reported changes in pain severity. *Ann Emerg Med* 1996; 27: 485–489.
20. Nandhra S, Wallace T, El-Sheikha J, et al. A randomised clinical trial of buffered tumescent local anaesthesia during endothermal ablation for superficial venous incompetence. *Eur J Vasc Endovasc Surg* 2018; 56: 699–708.
21. De Jong RH. *Local anesthetics*. St. Louis/London: Mosby, 1994.
22. Cousins MJ and Bridenbaugh PO. *Neural blockade in clinical anesthesia and management of pain*. 2nd ed. New York: Lippincott, 1988.
23. Samdal F, Amland PF and Bugge JF. Plasma lidocaine levels during suction-assisted lipectomy using large doses of dilute lidocaine with epinephrine. *Plast Reconstr Surg* 1994; 93: 1217–1223.
24. Ostad A, Kageyama N and Moy RL. Tumescent anesthesia with a lidocaine dose of 55 mg/kg is safe for liposuction. *Dermatol Surg* 1996; 22: 921–927.
25. Rubin JP, Bierman C, Rosow CE, et al. The tumescent technique: the effect of high tissue pressure and dilute epinephrine on absorption of lidocaine. *Plast Reconstr Surg* 1999; 103: 990–996; discussion 7-1002.
26. Li J, Zhou L and Wang Y. The effects of music intervention on burn patients during treatment procedures: a systematic review and meta-analysis of randomized controlled trials. *BMC Complement Altern Med* 2017; 17: 158.
27. Bradt J, Dileo C and Shim M. Music interventions for preoperative anxiety. *Cochrane Database Syst Rev* 2013; 6: Cd006908.
28. Mitchell M. Conscious surgery: influence of the environment on patient anxiety. *J Adv Nurs* 2008; 64: 261–271.
29. Caddick J, Jawad S, Southern S, et al. The power of words: sources of anxiety in patients undergoing local anaesthetic plastic surgery. *Ann R Coll Surg Engl* 2012; 94: 94–98.
30. Thompson KD, Welykyj S and Massa MC. Antibacterial activity of lidocaine in combination with a bicarbonate buffer. *J Dermatol Surg Oncol* 1993; 19: 216–220.
31. National Institute for Health and Care Excellence. Varicose veins in the legs – the diagnosis and management of varicose veins (Clinical guideline 168), https://www.nice.org.uk/guidance/cg168/ (accessed 6 September 2019).