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Technique and early results of ultrasound-guided foam sclerotherapy of the long saphenous vein for treatment of varicose veins

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ABSTRACT

Introduction: The aim of this study was to describe an original technique of using ultrasound-guided foam sclerotherapy in the long saphenous veins (LSV) for the treatment of varicose veins, and report the early results.

Methods: Only patients with lower limb varicose veins and demonstrable incompetent saphenofemoral junction with reflux down the LSVs underwent ultrasound-guided injection of foam sclerosant into the LSV. Foam sclerosant was made by the Tessari's method using three percent sodium tetradecyl sulphate to air in a 1:3 ratio. The LSV was accessed below the knee with a micropuncture set. A Headhunter angiographic catheter was cut to length and advanced over a guide wire to the saphenofemoral junction (SFJ). With the patient in the Trendelenburg position and the leg raised, the SFJ was manually compressed and foam was injected into the Headhunter catheter while the tip was withdrawn. Direct ultrasound visualisation ensured accurate catheter placement.

Results: 66 lower limbs in 62 patients were treated in the manner described above. The diameter of the treated LSV ranged from 4 to 13.4 mm. Ultrasound duplex assessment one day post-treatment showed complete occlusion in 62 veins (94 percent). Early complications included superficial thrombophlebitis, skin pigmentation, cellulitis and thrombosis of the superficial femoral vein.

Conclusion: Immediate results using our method of ultrasound-guided foam sclerotherapy showed a high obliteration rate of the LSV.

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INTRODUCTION

Lower limb venous insufficiency is a common medical condition and it affects an estimated 15% of men and 25% of women.[1] Patients with venous insufficiency may suffer heaviness, aching and cramps of the lower limbs. Chronic venous insufficiency gives rise to skin changes such as oedema, eczema, hyperpigmentation, lipodermatosclerosis and ulceration. The effect of lower limb venous insufficiency on patients' health-related quality of life is substantial and comparable to other chronic conditions such as diabetes mellitus and cardiovascular disease.[2] Incompetence of the saphenofemoral junction (SFJ) with reflux of venous blood down the long saphenous vein (LSV) is often the cause of primary varicose veins of the lower limbs. Surgical ligation at the SFJ with stripping of the LSV provides an effective, long-term solution.[3,4]

Open surgery is to date the gold standard for the treatment of lower limb varicose veins. This, however, entails the use of general or regional anaesthesia and necessitates a groin incision for surgical dissection of the SFJ. Non-surgical treatment options include compression hosiery, radiofrequency ablation, endovenous laser ablation and sclerotherapy. Liquid sclerotherapy is an established method of causing venous occlusion by the injection of sclerosing liquid into affected veins. Direct contact of sclerosant with the venous endothelium initiates endothelial and contigious mural injury. A local, wall-adherent thrombus then forms and subsequent sclerosis transforms the treated vein into a fibrous cord.[5]

The use of foamed sclerosants has been described since 1944, when Orbach injected a small amount of air into the venous segment targeted for treatment in order to displace blood and intensify the contact between sclerosant

and the endothelium.[6] Since then, various methods of creation of foamed sclerosant, where liquid sclerosant is forcibly mixed with air, oxygen or carbon dioxide, have been described.[7,8] Foam sclerotherapy has been shown to successfully treat lower limb varicose veins.[8-12] Superior to liquid sclerotherapy, its success is largely attributed to the qualities of foam – it displaces blood and creates an increased effective surface area of contact between the sclerosant and endothelium.[13] We describe an original technique of the ultrasonographically-guided introduction of foamed sclerosant via a vascular catheter into the LSV of patients with primary varicose veins. This method allows for precise administration of foam sclerosant into the entire length of the LSV under direct ultrasonographical vision.

METHODS

Patients seen in the vascular surgical outpatient clinic with varicose veins are assessed with a continuous-wave handheld Doppler. Those with incompetent SFJs and who prefer minimally-invasive intervention or are unfit for surgery are given the option of foam sclerotherapy of the LSV. Absolute contraindications include a known allergy to the sclerosant, acute superficial or deep venous thrombosis, severe systemic disease, patent foramen ovale and pregnancy. The study was approved by the Singapore General Hospital Institutional Review Board, and all patients gave written informed consent prior to the procedure.

In our practice, foam sclerotherapy was performed in the Ambulatory Surgical Centre in a clean operating theatre with full resuscitation facilities under local anaesthesia. The patient was placed in the supine position. Shaving, sterile cleansing and draping of the affected limb was performed as for conventional varicose vein surgery. The lower limb was exposed from the groin to the mid-calf. This allowed for a venous cut-down to access the LSV if the need arose. Ultrasound guidance was employed, and a Doppler probe was rendered sterile by placement in a sterile laparoscopic sleeve. An 8 or 10 mHz Doppler probe was used. Sterile gel was applied to the head of the probe and covered with two pieces of Tegaderm with care taken to ensure that no bubbles were included. A sterile rubber band was used to secure the prepared head. The LSV was then scanned from below the knee to the SFJ. The diameter of the LSV was measured just below the SFJ and recorded.

A sterile latex glove was used as a tourniquet and applied above the knee. This dilated the vein distally. Lignocaine was administered at the identified puncture site. A Micropuncture Access Set (Cook MPIS-401-U, Bloomington, IN, USA) consisting of a 21 G needle, 0.018" guide wire and 4-Fr transitional dilator was used for venous access. Venous entry was guided by ultrasound and obtained 5–10 cm below the knee. A J curve 0.035" guide wire (Diomed Inc, Andover, MA, USA) was then inserted. The dilator was removed and the J tip guide wire was advanced under real-time ultrasound guidance across the SFJ. Next, a 5-Fr 0.038" Headhunter catheter (Terumo Corporation, Tokyo, Japan) was measured and cut to length. This was passed over the guide wire until the tip sat just 1 cm distal to the SFJ. If necessary, venotomy by an Intradyn 1.3 × 70 mm 18 G puncture needle (B Braun Melsungen AG, Melsungen, Germany) to facilitate passage of the catheter into the vein was created. The J curve guide wire was then withdrawn.

Foam sclerosant was prepared using the Tessari's method. Two 20-ml syringes were connected by a three-way tap. One was filled with 3% sodium tetradecyl sulphate and the other syringe was filled with air. The ratio of sclerosant to air was 1:3, with total volume dependent on the size of the LSV (range 4–12 ml). The sclerosing solution and air were drawn back and forth by pump movement (20 times) to create a foam sclerosant which was stable for five minutes. The patient was then tilted to the Trendelenburg position. An assistant simultaneously compressed the SFJ and elevated the limb to 45°. Foam sclerosant was injected into the Headhunter catheter while withdrawing the catheter. Visualisation of the echogenic foam bubbles directly demonstrated the introduction of sclerosant. After removal of the catheter, digital compression of the puncture site was applied. Firm and precisely applied pressure reduced the risk of extravasation of sclerosant, which may lead to inflammation and ulceration. The ultrasound probe was used to massage echogenic foam in the vein distally into the tributaries under scan visualisation.

A gauze pack was then applied to the SFJ region and the distal puncture site, and firmly compressed with a crepe bandage. The lower limb was bandaged from the groin to the foot. An elastic bandage was used to reinforce the upper end to prevent the crepe bandage from slipping down. The patient was then advised to walk the corridors of the Ambulatory Surgical Centre for half an hour prior to discharge. This promoted rapid displacement of any foam within the deep venous system, thus minimising the development of deep venous thrombosis. All patients were scheduled for a formal venous Doppler assessment the following day, to exclude deep vein thrombosis and to confirm thrombosis of the LSV.

RESULTS

From March 2006 to August 2007, a total of 66 LSVs in 62 patients underwent the described technique of ultrasound-

guided foam sclerotherapy. The patients comprised 18 males and 44 females, ranging in age from 29 to 78 years. These patients had no previous interventions to the SFJ or LSV. The LSV diameters ranged from 4 mm to 13.4 mm (mean 7.6 mm). We reported on the results of an immediate postoperation ultrasound scan done one day after sclerotherapy and early, post-procedural complications (Tables I and II). Out of the 66 treated LSVs, 62 veins (94%) were completely thrombosed. Four (6%) were partially obliterated with residual reflux down the LSV. Three of these patients received a second injection of foam sclerosant, with resultant complete obliteration of the vein. The remaining patient declined repeat foam sclerotherapy, as she noted the lower limb varicosities to have shrunk in size.

The major early complication encountered was that of thrombosis of the deep venous system. Five lower limbs in five patients had ultrasonographical evidence of thrombosis of the superficial femoral vein (SFV). Four had partial thrombosis and one had complete thrombosis of the SFV. All five patients were asymptomatic. The patient with complete thrombosis of the SFV underwent a surgical thrombectomy. Coupled with the use of low-molecular-weight (LMW) heparin, this patient had complete resolution of the clot within the SFV. Those with a partially-thrombosed SFV were managed with LMW heparin in an outpatient setting. All showed ultrasonographical resolution by week six. None developed pulmonary embolism.

Minor complications include superficial thrombophlebitis, skin discolouration and cellulitis. Five of the 66 treated lower limbs (7.6%) developed superficial thrombophlebitis of the LSV. The pain experienced by these patients was relieved with oral analgesia and complete resolution was noted in all five patients. Skin discolouration and pigmentation was noted in four limbs (6.1%). Hyperpigmentation around the site of injection improved with time. One patient (1.5%) developed a lower limb cellulitis after foam sclerotherapy. This patient was admitted and received intravenous antibiotic therapy. A complete recovery was made.

Table I. Immediate postoperation ultrasonographical scan results.

Study data	No. (%)
No. of patients	62
No. of limbs	66
Ultrasound scan:	
Complete occlusion	62 (94)
Partial thrombosis	4 (6)

Table II. Early complications associated with foam sclerotherapy.

Early complication	No. (%) of patients
Thrombophlebitis	5 (7.6)
Skin discolouration and pigmentation	4 (6.1)
Cellulitis	1 (1.5)
Deep venous thrombosis (DVT)	
Superficial femoral vein	
Partial	4 (6.0)
Complete	1 (1.5)

DISCUSSION

Foam sclerotherapy has been shown to effectively treat primary varicose veins in the lower limbs by obliteration of the LSVs. Compared to surgery, it does away with the need for general or regional anaesthesia. Treatment time is also shorter and recovery, faster. Relative to other endovascular techniques of laser and radiofrequency ablations, the use of foam sclerotherapy is significantly more cost effective. Various previous reports have described the use of ultrasound guidance for foam sclerotherapy. We have given a detailed description of our unique technique of administering foamed sclerosant into the LSV. By employing a vascular catheter, the precise deposition of foam along the whole length of the LSV is possible. The use of ultrasound throughout the procedure allows for direct visualisation to ensure accurate cannulation and catheter tip placement. It also enables the surgeon to guide foam distribution throughout the vein and its tributaries.

All our patients treated with this method were able to ambulate immediately post-procedure and left the hospital on the same day. Every patient then returned a day later for an ultrasonographical examination of their lower limb venous system to assess obliteration of the LSV and screen for deep vein thrombosis. Obliteration of the LSV one day post-procdure was high at 94% of treated limbs. Ultrasonographical evaluation showed complete thrombosis of these veins with complete elimination of retrograde flow down the LSV. This efficacy is similar to, and on the high end of, reported obliteration rates of 60.0%–98.8% in the English literature.

Although none of our patients were symptomatic for deep venous thrombosis, the post-procedure ultrasonography picked up five instances of thrombosis (four partial, one complete) of the deep venous system. Despite the use of ultrasound-guidance, limb elevation during the procedure to prevent the foam from entering the deep venous system and immediate post-procedural ambulation to dilute any foam sclerosant that may have entered the deep venous system, deep venous thrombosis still occurred. Notably, these patients were all asymptomatic and the diagnosis of deep venous thrombosis was only made on the routine

post-procedural ultrasound examination. From previous trials and case series, the rates of deep venous thrombosis have been reported to be 0%–6%.[14] These studies did not routinely perform immediate ultrasonographical evaluation. Conceivably, many subclinical events would be missed in the absence of post-procedural ultrasonographical evaluation.

The minor complications encountered in the immediate post-procedure period include skin pigmentation (6.1%), superficial thrombophlebitis (7.6%) and cellulitis (1.5%). These local effects were mostly mild and may have constituted a spectrum of the inflammatory effect of sclerosant. Patient distress was minimal, and most cases were resolved through the use of oral anti-inflammatory agents. The early results of our technique show much promise. The high obliteration rate with low adverse event profile makes it an attractive alternative to surgery and other more costly endovascular techniques. Longer term follow-up of patients who received this form of foam sclerotherapy would better determine efficacy on ulcer healing, rates of recurrence and long-term complications, if any.

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