Role of tumescent fluid infiltration during saphenous stripping and ligation operation of varicose veins to reduce postoperative complications

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Objectives
Saphenous stripping and high ligation is the traditional operation for varicose veins globally. Postoperative complications like pain, subcutaneous ecchymosis, hematoma, and wound dehiscence are possible. The study assesses the role of ultrasound-guided tumescent fluid infiltration through saphenous fascia to reduce these complications.
Patients and methods
A single-arm prospective cohort study was conducted on 300 cases between February 2020 and February 2022 at Ain Shams University Hospital and Shebin El-Kom Teaching Hospital.
Results
A total of 300 patients who received saphenous stripping and high ligation operation were associated with ultrasound-guided infiltration of tumescent solution through saphenous fascial. Pain was assessed by visual analog scale score between first day and 1 week, which showed significant improvement. Ecchymosis was assessed based on the ecchymosis score between 1 and 4 weeks, with significant improvement. Subcutaneous hematoma and wound complications were also observed at 1 and 4 weeks, without significant improvement.
Conclusions
Ultrasound-guided tumescent solution infiltration along saphenous fascia possibly improves postoperative pain score and ecchymosis but not hematoma and wound complications.

Keywords:
saphenous stripping, stripping and high ligation, tumescent solution, varicose veins

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Background

Traditional stripping and high ligation is the most common surgical intervention to treat varicose veins globally [1]. Although there are recent therapeutic modalities of varicose vein treatment like laser, radiofrequency, and foam sclerotherapy, open stripping and high ligation is still the traditional option to treat varicose veins of the lower extremities [2–4]. However, subcutaneous ecchymosis, hematoma, wound complications, and pain discomfort are possible postoperative complications with this operation. Those postoperative complications still exert certain adverse effects on patients after operation [5,6].

Patients and methods

This is a single-arm prospective cohort study conducted on 300 cases that were treated between February 2020 and February 2022 at both Ain Shams University Hospital and Shebin El-Kom teaching hospital. Those cases that presented with unilateral lower limb primary varicose veins with clinical grade C3–C6 according to the International Venous Alliance Clinical-Etiological-Anatomical-Pathophysiological (CEAP) classification were treated by open surgical stripping and high ligation of great saphenous veins (GSV), short saphenous veins, or both. The study assessed the effect of ultrasound-guided tumescence inject along saphenous fascia and its role in reducing postoperative complications related to the traditional open surgery. This research was performed at the Department of General Surgery, Ain Shams University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

Inclusions and exclusions criteria

Inclusion criteria

Primary varicose veins with incompetent saphenofemoral junction (SFJ) and/or saphenous-popliteal

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junction (SPJ) incompetence, and age over 18 years and less than 65 years were the inclusion criteria.

Exclusions criteria

The exclusion criteria were as follows:(a) secondary varicose veins due to previous deep venous thrombosis and/or iliac vein compression (May Turner syndrome), (b) recurrent varicose veins after open or endovenous ablation, (c) surgical high-risk patients like those with ischemic heart diseases and renal and hepatic impairments, and (d) pregnancy.

The GSV, short saphenous vein, and the superficial and deep veins of the common femoral vein to the crural veins were examined by duplex ultrasound examinations (Xario; Toshiba, Tokyo, Japan). Reflux was defined as reverse flow more than 0.5 second after the release of calf compression. Postoperative clinical assessment was done at first day, 1, and 4 weeks to assess pain according to visual analog scale (VAS) score, ecchymosis, hematoma, and wound complication.

Surgical technique

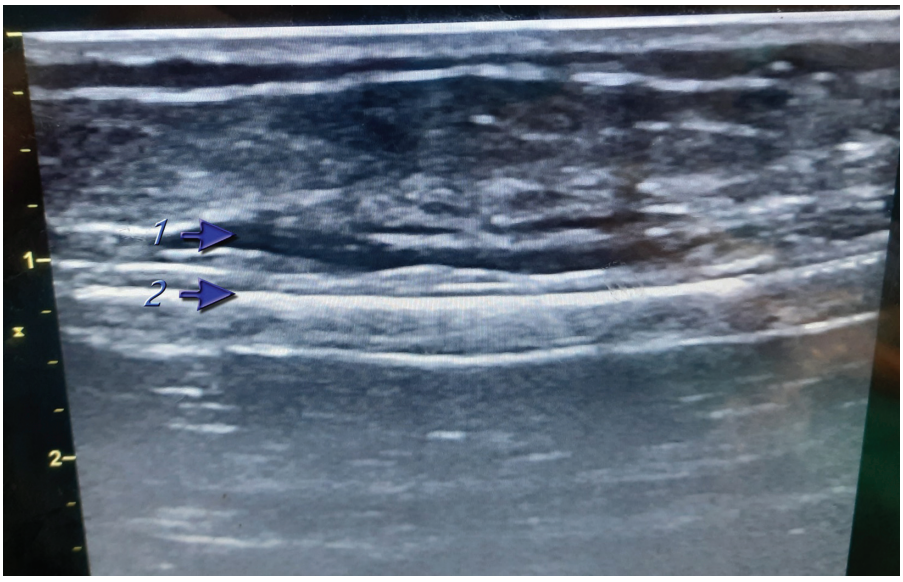
Surgical exposure of SFJ or/and SPJ was done through a small transverse incision about 3 cm at groin and leg, respectively. It was followed by surgical ligation of the junction and insertion of stripper with counter incision at just below knee in case of GSV stripping and just above lateral malleolus short saphenous stripping. The cases of short saphenous stripping are limited to patients presented clinically with pigmentation and ulcers and associated with pathological perforators. Otherwise, SPJ disconnection was sufficient to decrease the risk of sural nerve injury. Under ultrasound guidance, tumescent fluid was infiltrated before stripping to fill saphenous fascia (Fig. 1). It consists of 500 ml normal saline, 10-ml lidocaine (Xylocaine 2%), 5-ml bupivacaine (Marcaine 0.25%), and an ampule of bicarbonate 20 ml sodium bicarbonate 8.4% B.P. Surgical closure of subcutaneous tissue and skin after stripping of saphenous vein was done. All cases received postoperative flavonoid venotonic agent, painkiller (NSAIDs), and r-hirudin anti-inflammatory topical gel. There was no case on anticoagulation before or after the operation. All of the cases were encouraged early mobility and use of above knee elastic stocking to guard against deep venous thrombosis and postoperative subcutaneous hematoma formation.

Follow-up of cases was done. The skin ecchymosis was observed and evaluated after the removal of the skin bandage on 7th day postoperatively, and after 4 weeks to assess improvement and fading of ecchymosis. In this study, only skin ecchymosis of the thigh above the knee joint was observed. Skin ecchymosis was scored

Table 1 Ecchymosis score

Percentage area covered with ecchymosis	Ecchymosis score
0	0
<25	1
25–50	2
50–75	3
75–100	4
Extension above or below treated segment	5

Figure 1



Arrow 1 show tumescent solution during infiltration through saphenous fascia. Arrow 2 show stripper wire.

based on the percentage of treated area covered by ecchymosis, according to Table 1. Observations, measurements, and records of all skin ecchymosis were performed by authors.

Pain scores were recorded in all patients. VAS method was used to measure the pain level on the first day after surgery. In visual analog scoring, a 10-cm long Vernier caliper, with 10 scales on one side, was used, with '0' and '10' on both ends, 0 for pain, and 10 for the most intense unbearable pain. Patients were asked to select the appropriate location based on their subjective feelings, and the nurse read the score according to the scale. If the patient required analgesic medication owing to severe pain, VAS should be scored before the administration of medication. Similarly, pain VAS score of the patient was recorded by the same authors on the first day after surgery and at 1 week.

Statistical analysis

Data were collected, tabulated, and statistically analyzed using an IBM compatible personal computer with Statistical Package for the Social Sciences (SPSS), version 23 (SPSS, IBM company, New York, USA). Qualitative data were expressed as number and percentage, whereas quantitative data were expressed as mean, SD, and range (minimum–maximum). Friedman test was used for comparison of VAS score between more than two consecutive measures in the same group of not-normally distributed data. McNemar's test was used to evaluate paired categorical data measured only two times with only two outcomes.

Result

The study included 300 patients. Two-thirds of the cases were men, whereas one-third were women. The mean±SD age (range) was 42.43±11.43 (28–61) years. Active smoker patients were 10%, whereas ex-smokers were 53.3%. There was no case with ischemic heart disease nor with renal insufficiency. Overall, 10% only were obese (30 cases). The demographic data are listed in Table 2.

Table 2 The demographic data

	n (%)
Age (years)	42.43±11.43 (28.0–61.0)
Sex	
Male	203 (66.7)
Female	97 (33.3)
Smoking	30 (10)
Ex-smoker	160 (53.3)
Years of smoking	2.63±1.57 (1.0–7.0)
Obesity	30 (10)
DM	10 (3.3)
HTN	40 (13.3)
Hypercholesterolemia	10 (3.3)
IHD	0
CHF	0
CVA	0
Renal insufficiency	0

Patients who presented clinically with CEAP classification three (edema) were 228 (76%) cases, CEAP 4 (pigmentation) were 39 (13%) cases, whereas CEAP 5 and 6 (healed or active ulcer) were 33 (11%) cases. Preoperative investigation and clinical presentation are listed in Table 3.

Operations were done under spinal anesthesia in 210 (70%) patients, whereas 90 (30%) patients were under general anesthesia. We treated 240 cases with incompetent SFJ alone (80.1%), 40 (13.3%) cases with incompetent SPJ alone, and 20 (6.7%) cases had both SFJ and SPJ incompetence.

Clinical assessment of patient with assistance of ultrasound was done at first day postoperatively, 1 week postoperatively, and 4 weeks postoperatively. Pain had improved.

Pain assessment was based on the VAS score. There was a statistically significance reduction in VAS score when compared between first day and 1 week postoperatively (Table 4).

Table 3 Preoperative investigation and clinical presentation

Total leukocyte count	6.04±1.68 (4.0–9.8)
Platelet	222.57±41.47 (156.0–314.0)
Hemoglobin	12.37±1.50 (10.0–14.8)
Serum creatinine	0.99±0.13 (0.80–1.37)
BUN	26.62±5.67 (11.0–39.0)
ALT	24.60±4.97 (14.0–41.0)
AST	32.37±11.86 (16.0–58.0)
PT	12.32±0.82 (11.0–13.7)
PTT	90.18±14.81 (37.7–100.0)
INR	1.02±0.03 (1.0–1.1)
	n (%)
Varicose veins	300 (100)
Edema	228 (76)
Pigmentation	39 (13)
Ulcer	33 (11)

Table 4 First day and 1-week postoperative pain assessment using visual analog scale score

VAS score	1-day postoperative	1-week postoperative	Wilcoxon (*P* value)
Mean ±SD	5.03±0.96	1.73±1.01	4.809
Range	4.0–7.0	0.0–4.0	<0.001

VAS, visual analog scale. *P* value less than 0.001: highly significant.

Table 5 1-week and 4-week postoperative clinical assessment of ecchymosis, hematoma and wound

	1-week postoperative [*n* (%)]	4-week postoperative [*n* (%)]	*P* value*
Ecchymosis			
Yes	52 (17.33)	0	<0.001
No	248 (82.6)	300 (100.0)	
Hematoma			
Yes	20 (6.7)	0	0.500
No	280 (93.3)	300 (100.0)	
Wounds dehiscence	20 (6.7)	0	0.500
Clean	280 (93.3)	300 (100.0)	

**P* value for McNemar test, *P* value less than 0.001: highly significant.

There were 52 cases who presented with ecchymosis at 1 week postoperatively, 35 cases (about two-third of cases) had ecchymosis score 1 (<25% of treated area is covered by ecchymosis), whereas 17 cases (about one third of cases) had ecchymosis score 2 (25–50% of treated area is covered by ecchymosis). All cases were cured totally at 4 weeks, with statistically significant improvement. A total of 20 cases presented at 1 week postoperatively with mild hematoma and another 20 cases with wound dehiscence; all were cured at 4 weeks, without statically significant improvement (Table 5).

Discussion

At present, most hospitals or centers focus more on learning new technologies, while neglect traditional operations, and the details of reducing postoperative complications. High ligation and saphenous stripping operation has potential complication of postoperative pain and numbness, subcutaneous ecchymosis, hematoma, and femoral vein injury [7–9].

According to previous literature, postoperative subcutaneous ecchymosis can reach to ~80% [10]. Ecchymosis is defined as a large amount of discoloration caused by blood infiltration into the subcutaneous tissue [11]. During high ligation and stripping of the GSV, the collateral veins are torn apart after stripping the GSV trunk; thus, parts of the veins are retracted into the tissue owing to shrinkage of the blood vessels, which is considered as the main cause of subcutaneous ecchymosis. Postoperative complications, such as pain and ecchymosis, could prolong the hospitalization time of patients, increase medical burden, greatly affect patients' medical experience, and even become the disputed point of doctor–patient relationship.

Tumescent solution is commonly used in plastic surgery, vascular surgery, and breast surgery, which has the advantage of reducing bleeding and pain [12,13]. Tumescent solution is defined as a mixed solution of adrenaline and local anesthetic. The contraction effect of adrenaline on small blood vessels and the swelling effect on the vein serve as a good hemostasis [14]. A combination of short-acting lidocaine and long-acting bupivacaine can decrease pain, which work well together and are regarded as the main cause of postoperative pain relief [15].

There are possible advantages if tumescent solution is infiltrated in saphenous fascia. First, the pervious tissue is anesthetized, and the anesthesia fluid infiltrates along the space around the GSV to exert certain anesthetic effects on the peripheral nerves and to effectively reduce postoperative pain. Second, the infiltration of tumescent solution along the main saphenous vein can play a role in compressing the tissue blood vessels, and hemostatic effect of adrenaline could be achieved. There is no definitive study related to the role of tumescent solution infiltration to reduce postoperative stripping and ligation complications. However, it has been applied in various plastic operations since 1987, when Klein first infiltrated a large number of diluted adrenaline-containing lidocaine solution into the subcutaneous fat layer for local fat aspiration anesthesia, namely, swelling anesthesia [16]. It is used owing to its safety, less blood loss, less tissue damage, prolonged anesthesia time, and good analgesic effect achieved [14].

Weak points in this study are it is a single-arm prospective study, and there is no comparison with control group. Because we believe in efficacy of tumescent solution infiltration to reduce postoperative complications such as ecchymosis, hematoma, and pain, our study was single arm and could be comparable to data reported in the literature. Pain score is subjective to patient and could not be assess in an objective manner.

Conclusions

Ultrasound-guided tumescent fluid infiltration along saphenous fascia possibly improves postoperative pain score and ecchymosis but not hematoma and wound complications.

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Conflicts of interest
There are no conflicts of interest.

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