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Clinical Efficacy and Safety Analysis of Ultrasound-Guided Local Anesthesia for Endovenous Laser Combined with Sclerotherapy in the Treatment of Varicose Great Saphenous Veins

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Abstract: *Objective*: To investigate the clinical efficacy and safety of ultrasound-guided local anesthesia for endovenous laser combined with sclerotherapy in the treatment of varicose great saphenous veins. *Methods*: A total of 53 patients with varicose great saphenous veins admitted to our hospital from December 2023 to June 2025 were selected and divided into a traditional surgery group (18 cases) and a laser combined with sclerotherapy group (35 cases) according to the surgical method. The venous clinical severity score (VCSS), chronic venous insufficiency quality of life questionnaire (CIVIQ) score, visual analog scale (VAS) score for pain, complication rate, surgical time, treatment cost, recovery time, and patient satisfaction were compared between the two groups at 1 week, 1 month, and 3 months postoperatively. *Results*: The VCSS scores of the laser group at each postoperative time point were lower than those of the traditional group, and the CIVIQ scores were higher than those of the traditional group (all $p < 0.05$). The incidence of complications in the laser group (8.57%), the VAS score at 24 hours postoperatively, the duration of pain, and the utilization rate of analgesic medications were all significantly lower than those in the conventional group (all $p < 0.05$). The laser group also demonstrated shorter operative and recovery times compared to the conventional group, along with higher patient satisfaction, albeit at a higher treatment cost ($p < 0.05$). *Conclusion*: Endovenous laser combined with sclerotherapy under ultrasound guidance for the treatment of great saphenous vein varicosis offers advantages such as minimal trauma, rapid recovery, mild pain, and fewer complications, demonstrating significant clinical efficacy and good safety, thus possessing high clinical application value.

Keywords: Great saphenous vein varicosis; Endovenous laser therapy; Sclerosant; Ultrasound guidance; Clinical efficacy

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1. Introduction

Great saphenous vein varicosis is a common vascular disease caused by incompetence of the venous valves in the lower extremities, characterized primarily by tortuous and dilated veins, as well as heaviness and soreness in the lower limbs. In severe cases, skin ulcers may develop, affecting the patient's quality of life [1]. Traditional treatment methods primarily involve high ligation and stripping, which, although effective in removing diseased veins, have drawbacks such as significant trauma, slow recovery, and a high incidence of complications [2]. With the development of minimally invasive techniques, ultrasound-guided endovenous laser combined with sclerotherapy has gradually been applied in clinical practice due to its advantages of high precision and minimal trauma. This study aims to provide a reference for the minimally invasive treatment of varicose veins of the great saphenous vein by comparing the clinical efficacy and safety of two surgical methods.

2. Materials and methods

2.1. General information

A total of 53 patients with varicose veins of the great saphenous vein who were treated in the surgical department of our hospital from December 2023 to June 2025 were selected and divided into two groups based on different surgical methods: the traditional group (18 cases) and the laser group (35 cases). In the traditional group, there were 10 males and 8 females, with ages ranging from 32 to 68 years old and an average age of (51.36 ± 8.24) years; 15 cases had unilateral disease and 3 cases had bilateral disease. In the laser group, there were 19 males and 16 females, with ages ranging from 30 to 69 years old and an average age of (50.78 ± 7.96) years; 29 cases had unilateral disease and 6 cases had bilateral disease. The comparison of general information between the two groups ($p > 0.05$) indicated comparability. This study was approved by the Medical Ethics Committee of the hospital, and all patients signed informed consent forms.

2.1.1. Inclusion criteria

Diagnosis of primary great saphenous vein varicosis; age between 18 and 70 years old; unilateral or bilateral involvement; CEAP classification: C2–C6.

2.1.2. Exclusion criteria

Non-primary varicose veins; severe liver and kidney diseases; acute thrombosis in the great saphenous vein or deep veins; allergy to local anesthetic drugs; patients with malignant tumors; patients with uncontrolled active systemic infectious diseases.

2.2. Research methods

2.2.1. Experimental equipment and materials

Semiconductor laser therapy device (Model FD-30-A), Sino peristaltic pump (iPump6S), Philips intelligent ultrasound diagnostic system (PHILIPS EPIQ7), 1% or 3% polidocanol sclerosant.

2.2.2. Preoperative preparation

All subjects underwent blood analysis, including red blood cell count (RBC) and mean corpuscular volume (MCV), coagulation time measurement, liver and kidney function tests, as well as bilateral limb vascular ultrasound

examinations to determine the presence of absolute or relative contraindications for surgery; they also completed a baseline information form recording CEAP classification, VCSS score, and CIVIQ questionnaire results; the laser group additionally underwent perineal and inguinal skin preparation, and fasting was not required before surgery.

2.2.3. Surgical methods

(1) Traditional group

After general anesthesia or epidural anesthesia, an incision was made below the inguinal ligament. The main trunk and branches of the great saphenous vein were dissected and ligated. A stripping device was inserted to strip the vein, and the varicose vein masses were subjected to punctate stripping. The incision was then sutured and compressed with bandages.

(2) Laser group

Under local tumescent anesthesia, the great saphenous vein was punctured under ultrasound guidance, and a vascular sheath was placed. A laser fiber was introduced to a point 2 cm distal to the saphenofemoral junction, and the main trunk of the great saphenous vein was ligated. Tumescent anesthesia was administered under ultrasound guidance, and the laser fiber was withdrawn segmentally at a power of 12–15 W to close the vein. Subsequently, a sclerosing agent was injected, and punctate stripping of the varicose veins was performed, followed by suturing of the incision.

2.2.4. Postoperative management

Both groups received anti-infective, analgesic, and anticoagulant therapy. Elastic stockings were changed 48 hours postoperatively and worn for 2 weeks to 3 months. Symptomatic treatment was provided for conditions such as allergies and exudation.

2.3. Observation indicators

2.3.1. Efficacy indicators

At 1 week, 1 month, and 3 months postoperatively, VAS scores (ranging from 0 to 3, with lower scores indicating better recovery of motor function) and CIVIQ scores (ranging from 0 to 100, with higher scores indicating better quality of life) were assessed in both groups, and recurrence was recorded.

2.3.2. Complication and pain indicators

The occurrence of complications in patients from both groups was statistically analyzed, and the Visual Analogue Scale (VAS) scores [ranging from 0 to 10 (VAS is a visual analog scale, with higher scores indicating more severe pain)] at the 24th hour post-surgery, the duration of pain, and the proportion of patients using analgesic medications were recorded for each case.

2.3.3. Other indicators

Record the operation time, treatment cost, and time to return to daily activities; assess satisfaction using a Likert five-point scale at 1 week, 1 month, and 3 months post-surgery, and calculate the overall satisfaction rate (the proportion of grades C, D, and E).

2.4. Statistical methods

Data analysis was conducted using SPSS 26.0 software. Measurement data were expressed as ($\overline{x} \pm s$), and comparisons of mean values between the two groups were performed using the *t*-test; measurement data were expressed as [n(%)], and comparisons between groups were conducted using the χ^2 test; a *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of efficacy indicators between the two groups

There were no significant differences in preoperative VCSS and CIVIQ scores between the two groups ($p > 0.05$); at each postoperative time point, the laser group had lower VCSS scores and higher CIVIQ scores than the traditional group ($p < 0.05$). No recurrence was observed in either group during the follow-up period. See **Table 1** for details.

Table 1. Comparison of efficacy indicators ($\overline{x} \pm s$, points)

Group	1-Week Postop VCSS	1-Month Postop VCSS	3-Month Postop VCSS	1-Week Postop CIVIQ	1-Month Postop CIVIQ	3-Month Postop CIVIQ
Traditional (n = 18)	5.26 ± 1.13	3.87 ± 0.95	2.76 ± 0.73	68.43 ± 7.21	76.59 ± 6.42	83.74 ± 5.86
Laser (n = 35)	3.12 ± 0.85	1.98 ± 0.62	1.25 ± 0.41	82.56 ± 6.34	91.32 ± 5.17	96.48 ± 3.29
t-value	7.071	7.645	8.140	7.033	8.430	8.556
p-value	0.000	0.000	0.000	0.000	0.000	0.000

3.2. Comparison of complications and pain indicators between the two groups

The incidence of complications, 24-hour VAS score, duration of pain, and the usage rate of analgesics in the laser group were all lower than those in the traditional group ($p < 0.05$). See **Table 2** for details.

Table 2. Comparison of complications and pain indicators

Group	Complication rate [n (%)]	24h postop VAS score (points)	Pain duration (d)	Analgesic use rate [n (%)]
Traditional (n = 18)	6 (33.33)	4.86 ± 1.24	5.72 ± 1.36	12 (66.67)
Laser (n = 35)	3 (8.57)	2.15 ± 0.78	2.31 ± 0.85	5 (14.29)
Statistical value	5.170	8.452	9.707	14.970
p-value	0.023	0.000	0.000	0.000

3.3. Comparison of other indicators between the two groups

The operation time and the time to resume daily activities in the laser group were shorter than those in the traditional group, while patient satisfaction was higher. However, the treatment cost in the laser group was higher than that in the traditional group ($p < 0.05$). See **Table 3** for details.

Table 3. Comparison of other indicators between the two groups of patients

Group	Operative time (min, Mean ± SD)	Treatment cost (CNY, Mean ± SD)	Time to resume daily life (days, Mean ± SD)	Patient satisfaction [n (%)]
Traditional (n = 18)	78.34 ± 12.56	8732.45 ± 1124.63	10.57 ± 2.14	12 (66.67)
Laser (n = 35)	42.65 ± 8.37	12865.34 ± 1562.78	4.12 ± 1.03	33 (94.29)
t/χ^2 value	10.877	11.044	12.088	7.075
p-value	0.000	0.000	0.000	0.000

4. Discussion

The core pathological mechanism of varicose veins of the great saphenous vein is the obstruction of deep venous return caused by dysfunction of the communicating branches between deep and superficial veins and the calf muscle pump, accompanied by venous valve defects and/or incompetence, resulting in retrograde blood flow. This leads to an increase in proximal venous pressure, causing the diameter of distal veins to increase, and ultimately resulting in tortuous dilation [3]. Traditional surgical methods are prone to damaging adjacent tissues. The treatment approach combining ultrasound-guided endovenous laser therapy with sclerotherapy organically integrates the two methods, with the following characteristics

(1) Utilizing the photocoagulation effect of the laser to cause shrinkage and adhesion of the venous wall, completely blocking the reflux in the main trunk of the great saphenous vein;

(2) Injecting sclerosants such as polidocanol into the varicose veins to disrupt the venous endothelial cell layer and induce a series of reactions including thrombus formation and collagen deposition, ultimately achieving the permanent occlusion of the varicose veins in the lower leg [4]

(3) Using an ultrasound probe to accurately display the location of the veins requiring treatment and avoid important structures, thereby reducing the risk of neurovascular injury caused by blind puncture

(4) Local anesthesia reduces the risks associated with general anesthesia and aligns with the principles of enhanced recovery after surgery [5]

This study demonstrates that the laser group had lower postoperative VCSS scores and higher CIVIQ scores, confirming the efficacy advantages of minimally invasive techniques. Traditional surgery often causes postoperative pain and swelling due to traction on surrounding tissues during the stripping process. In contrast, the laser group, with its minimally invasive local anesthesia, experiences less trauma, and the swelling anesthesia fluid can mitigate thermal damage and pain transmission. Consequently, the 24-hour VAS score, duration of pain, and the use of analgesics were significantly reduced in the laser group [6].

In terms of complications, the incidence rate in the laser group was only 8.57%, significantly lower than the 33.33% in the traditional group. The drawbacks of traditional surgery include large wound areas, extensive resection ranges, and a higher likelihood of postoperative bleeding, infection, and saphenous nerve injury due to unclear anatomical layers and incomplete separation of vital structures [7]. In this trial, ultrasonic scalpel treatment was employed, where ultrasonic waves effectively transmit energy into the body, accelerating molecular vibrations in the target area to generate heat. This achieves high-temperature inactivation, reduces tissue damage, and lowers the incidence of complications such as ecchymosis and induration.

Regarding efficiency and satisfaction, the laser group experienced a 45.5% reduction in surgical time and a 61.1% reduction in the time required to resume daily activities. This is directly related to the characteristics of minimally invasive techniques, which require less extensive dissection, result in less intraoperative bleeding,

and facilitate faster postoperative recovery. Patient satisfaction reached as high as 94.29%, attributed not only to the therapeutic and recovery advantages but also to the small surgical scars and improved aesthetic outcomes, particularly appealing to younger patients [8].

In terms of treatment costs, the laser group was higher than the traditional group, primarily due to the relatively expensive prices of laser surgical instruments and medications [9]. However, when considering the overall situation, the potential benefits of laser therapy, such as shortening patients' hospital stays and postoperative recovery times, as well as reducing the likelihood of various complications and sequelae, still result in a high cost-effectiveness ratio [10].

5. Conclusion

In summary, endovenous laser combined with sclerotherapy under ultrasound-guided local anesthesia for the treatment of great saphenous vein varicosis can effectively improve clinical symptoms and quality of life. It offers advantages such as minimal trauma, mild pain, rapid recovery, and fewer complications. Although the treatment costs are relatively high, its overall safety and effectiveness are significant, making it worthy of clinical promotion and application.

Disclosure statement

The authors declare no conflict of interest.

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