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Clinical Results of Greater Saphenous Vein Closure and High Ligation and Stripping of Greater Saphenous Vein

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Abstract: This study aims to explore the clinical effects of endovenous laser therapy (EVLT) and modified high ligation and stripping in the treatment of great saphenous vein (GSV) varicosities. The clinical data of 84 patients with GSV treated in the department from January 2020 to December 2023 were collected, and the patients were divided into laser group and stripping group according to the different operation methods. Operation-related indicators (operation time, intraoperative blood loss, postoperative time of first ambulation, hospitalization time), the pain degree of 6h and 24h after surgery, the severity of varicose veins before and 3 months after surgery, the occurrence of complications within 3 months after surgery, and the efficacy of the two groups were compared. In the laser group, the amount of bleeding and incision was less, and the first ambulation and hospital stay were shorter than that of the stripping group ($P < 0.05$). The incidence of subcutaneous hematoma, saphenous nerve injury and total complications were significantly lower in the laser group than in the stripping group, but there was no significant difference in the incidence of incision infection, skin ecchymosis and thrombophlebitis between the two groups ($P > 0.05$). Compared with the treatment of high ligation and exfoliation, the treatment effect of both is the same, but the incidence of complications of internal cavity surgery is lower, and it has the advantages of less incision, light pain and beauty.

1. Introduction

Great saphenous veins, (GSV) varicose veins are one of the common lower limb venous diseases, usually primary in nature. They mainly result from superficial venous reflux and deep venous return obstruction, leading to long-term high pressure on the walls and valves of the superficial veins in the lower limbs. This results in tortuous dilation of the superficial veins and valve insufficiency, ultimately causing prolonged tortuosity of the veins. These conditions are more prevalent among people who stand or sit for long periods and engage in heavy physical labor [1]. The main clinical manifestations include heaviness, weakness, ankle swelling, and pigmentation of the skin in the lower limbs. In later stages, they can lead to endovascular inflammation, causing skin ulcers, bleeding, and superficial venous thrombosis [2]. Early treatment primarily involves high ligation

and stripping of the great saphenous vein, but this method is highly invasive, involves multiple surgical incisions, causes postoperative pain, and leaves an unsightly appearance. With technological advancements and increased patient demands for treatment, endovenous techniques have gradually been introduced in recent years. Endovenous laser treatment, (EVLT) has become one of the minimally invasive surgical methods, offering advantages such as minimal trauma, rapid recovery, and a good therapeutic experience [3]. This study retrospectively analyzed the clinical and follow-up data of patients with GSV varicose veins treated surgically to compare the effectiveness of traditional high ligation and stripping of the GSV with combined high ligation and EVLT.

2. Data and methods

2.1 General information

The clinical data of 84 patients with GSV varicosity who underwent surgical treatment in the Department of Cardiovascular Surgery, The Second Affiliated Hospital of Kunming Medical University from January 2020 to December 2023 were retrospectively analyzed.

2.1.1 Diagnostic criteria

All patients had the confirmed diagnosis of primary GSV varicose [4] based on medical history, clinical presentation, venous ultrasound of the lower limbs or venography of the affected limb. Variceus severity grading according to CEAP classification criteria: grade consists of clinical, etiology, anatomical and pathophysiology, and is divided into 7 grades of C0-C6.

2.1.2 Inclusion criteria

(1) meet the diagnostic criteria of primary great saphenous vein varicose; (2) all are unilateral great saphenous vein varicose; (3) clinical grade C2-C6; (4) age 18-78 years.

2.1.3 Exclusion Criteria

(1) Patients diagnosed with secondary varicose veins of the lower limbs due to iliac vein compression syndrome or arteriovenous fistula after lower limb venography; (2) Bilateral great saphenous vein varicosities; (3) History of lower limb vascular surgery; (4) Metabolic diseases such as diabetes, hematological disorders, or severe organic lesions in vital organs; (5) Pregnant or breastfeeding women; (6) Presence of deep vein thrombosis or thrombophlebitis in the lower limbs; (7) Missing follow-up.

2.1.4 Grouping

In this study, a total of 84 individuals were divided into two groups based on their surgical methods: the laser group and the stripping group. The laser group underwent high ligation of the great saphenous vein + main trunk EVLT + ultrasound-guided laser closure of the perforating branch of the saphenous vein + foam sclerotherapy, with 42 cases, accounting for 50.00%; the stripping group underwent high ligation of the great saphenous vein followed by stripping of the main trunk + point-wise stripping of varicose veins below the knee + foam sclerotherapy, also with 42 cases, accounting for 50.00%. There was no statistically significant difference in age, gender, affected limb, or CEAP grade between the two groups ($P>0.05$), making them comparable (see Table 1). All patients and their families signed informed consent forms, which were approved by the hospital's ethics committee.

Table 1 Comparison of baseline data between the two groups

variable	Total (n = 84)	Laser group (n = 42)	Debridement group (n = 42)	statistics	*P*
$age, \bar{x} \pm s$	53.24 ±6.03	52.48 ±6.66	54.00 ±5.28	t=-1.16	0.249
sex,n(%)				χ^2=0.19	0.662
man	40 (47.62)	19 (45.24)	21 (50.00)		
woman	44 (52.38)	23 (54.76)	21 (50.00)		
On the affected side of the limb, n(%)				χ^2=0.20	0.657
the left side	50 (59.52)	26 (61.90)	24 (57.14)		
right	34 (40.48)	16 (38.10)	18 (42.86)		
CEAP grade, n(%)				χ^2=0.28	0.595
C2~4	18 (21.43)	10 (23.81)	8 (19.05)		
C5~6	66 (78.57)	32 (76.19)	34 (80.95)		
Note: t: t-test, χ^2: Chi-square test					

2.2 Surgical approach

All patients completed cardiopulmonary function and preoperative examinations. The main trunk of GSV and the course of obvious varicose veins were marked with a marker pen before surgery, and the perforating branches of the knee vein were marked by bedside ultrasound.

2.2.1 Laser Group

The surgical procedure is performed as follows: First, the surgeon makes a 1 cm oblique incision 2 cm below the inguinal ligament and 0.5 cm medial to the femoral artery. The surgeon identifies the great saphenous vein (GSV) at its junction with the femoral vein, then mobilizes the GSV. The surgeon performs double ligation of the main trunk 0.5 cm from its deep venous origin. Under ultrasound guidance, the surgeon punctures the GSV trunk 5 cm below the knee, inserts a Terumo 5F sheath, and advances a 5F laser fiber to the distal end of the GSV for ligation. Next, the surgeon injects tumescent anesthetic subcutaneously along the GSV under ultrasound guidance. The surgeon activates the semiconductor laser (model: LASEmaR 1500) at 12W in continuous pulse mode to achieve endovenous closure. The surgeon withdraws the fiber at 0.5 cm/s while an assistant applies 5 minutes of manual compression along the fiber's red light path. Under ultrasound guidance, the surgeon punctures any varicose tributaries or perforators below the knee, inserts fine fibers, and reduces power to 8W for closure. For smaller branches, the surgeon prepares a foam sclerosing agent (1% polidocanol: air = 1:4) and injects 1-2 ml per site. Postoperatively, the surgical team applies an eccentric compression bandage, replaces it with a compression stocking on postoperative day 2, and maintains compression therapy for 6 months.

2.2.2 Debridement Group

The surgical procedure is performed as follows: First, the surgeon makes a 2 cm oblique incision 2 cm below the inguinal ligament and 0.5 cm medial to the femoral artery. The surgeon dissects through the subcutaneous tissue to expose the great saphenous vein (GSV), then sequentially ligates and divides 3–5 tributary branches. The surgeon transects the GSV 0.5 cm from its junction with the deep veins, then ligates and sutures the proximal stump. Next, the surgeon makes a small incision anterior to the medial malleolus, dissects to isolate the distal GSV, and ligates the distal end. The surgeon then introduces a venous stripping cannula into the proximal end. The surgeon performs multiple stab phlebectomies along the course of the GSV where varicosities are prominent. For

smaller varicose tributaries, the surgeon prepares 5 ml of foam sclerosing agent by mixing 1 ml of 1% polidocanol with 4 mL of air. The surgeon injects 1–2 ml at each puncture site to achieve chemical closure. After treating all branches, the surgeon strips the GSV main trunk. The assistant applies firm manual pressure for 10 minutes to achieve hemostasis. Postoperatively, the surgical team wraps the limb with an elastic compression bandage and transitions the patient to graded compression stockings for long-term therapy.

2.3 Observation indicators and evaluation criteria

The study evaluates and compares the following outcomes between the two patient groups: (1) Surgical time, intraoperative blood loss, time to first postoperative ambulation, and length of hospital stay are recorded and analyzed. (2) Postoperative pain is assessed using the Visual Analog Scale (VAS) at 6h and 24h after surgery, with scores ranging from 0 (no pain) to 10 (severe pain). Pain severity is categorized as mild (1–3), moderate (4–6), or severe (7–10). Disease severity is evaluated using the Venous Clinical Severity Score (VCSS) preoperatively and at three months postoperatively, with higher scores (0–30) indicating more severe symptoms. (3) Complications occurring within three months postoperatively—including subcutaneous hematoma, surgical site infection, skin bruising, thrombophlebitis, and saphenous nerve injury—are documented. (4) Follow-up assessments are conducted at three and six months postoperatively via telephone, WeChat, or SMS, combined with clinical evaluation and lower limb venous ultrasound to determine treatment efficacy." Recovery: No pain, swelling, or numbness in the affected limb after surgery, and no blood reflux in the GSV main trunk on venous ultrasound; Improvement: Mild swelling or numbness in the affected limb after surgery, affecting daily activities, and no blood reflux in the GSV on venous ultrasound; Non-recovery: Significant swelling and pain in the affected limb after surgery, with no relief or worsening of varicose veins, skin ulcers, etc., or blood reflux in the GSV main trunk on venous ultrasound.

2.4 Statistical processing

Continuous variables that follow a normal distribution $s \pm \bar{x}$ are expressed using mean ± standard deviation (), and inter-group differences are analyzed using the two-independent samples T-test. For variables that do not follow a normal distribution, median and quartiles [P50 (P25, P75)] are used, and inter-group differences are analyzed using the non-parametric Mann-Whitney test. Categorical variables are represented by frequency and percentage [n (%)], and for unordered categories, the chi-square test or fisher exact test is used to analyze inter-group differences. For ordered categorical variables (i.e., ordinal variables), the non-parametric Mann-Whitney test is used to analyze inter-group differences. A P value less than 0.05 indicates a statistically significant difference, and all analyses in this study were completed using SPSS25.0.

3. Results

3.1 Comparison of perioperative related indicators

The amount of bleeding and the number of surgical incisions in laser group were less than those in stripping group, and the time of getting out of bed for the first time and hospital stay were shorter than those in stripping group, all of which were statistically significant ($P<0.05$). The difference of surgical time between the two groups was not statistically significant ($P>0.05$) (see Table 2).

Table 2 Comparison of perioperative indicators between the two groups($\bar{x} \pm s$)

divide into groups	Surgical time	Number of surgical incisions	Intraoperative blood loss	The time after surgery when you get out of bed for the first time	length of stay
Laser group (n = 42)	51.86±10.89	3.62±0.76	12.14±5.51	7.43±0.83	3.67±0.53
Debridement group (n = 42)	55.95±16.10	5.83±1.82	27.62±7.93	9.05±1.59	4.02±0.41
t	-1.366	-7.270	-10.384	-5.844	-3.464
P	0.176	0.000**	0.000**	0.000**	0.001**
*P<0.05 **P<0.01					

3.2 Comparison of VAS and VCSS scores between laser group and stripping group patients

The VAS and VCSS scores of patients in the laser group and the excision group were compared, with no statistically significant difference in VAS scores at 6 h postoperative (P>0.05). The VAS score at 24 h postoperative in the laser group was significantly lower than that in the excision group, with a statistically significant difference (P<0.05). There was no statistically significant difference in preoperative VCSS scores between the two groups (P>0.05), but the VCSS score at 3 months postoperative in the laser group was significantly lower than that in the excision group, with a statistically significant difference (P<0.05) (see Table 3).

Table 3 Comparison of VAS scores and VCSS scores in the two patient groups（$\bar{x} \pm s$）

divide into groups	VAS grade		VCSS grade	
	Postoperative 6h	Postoperative 24h	Preoperative	Postoperative 3 months
Laser group (n = 42)	5.43±0.50	2.86±0.52	6.14±1.73	1.33±0.48
Debridement group (n = 42)	5.60±0.54	3.83±0.62	6.36±1.34	1.69±0.47
t	-1.461	-7.799	-0.634	-3.464
P	0.148	<0.001	0.528	<0.001

3.3 Comparison of postoperative complication rates between laser group and stripping group

The incidence of postoperative complications in the two groups was compared, and the incidence of subcutaneous hematoma, hidden nerve injury and total complications in the laser group was significantly lower than that in the stripping group (P<0.05), but there was no significant difference in the incidence of incision infection, skin bruise and thrombophlebitis between the two groups (P>0.05) (see Table 4).

Table 4 Comparison of postoperative complication incidence between the two groups [n(%)]

group	ecchymoma	infection of incisional wound	Bruising of the skin	thrombophlebitis	Nerve damage to the hypoglossal nerve	Overall incidence
Laser group (n = 42)	1(2.38)	0(0)	2(4.76)	1(2.38)	0(0)	4(9.52)
Debridement group (n = 42)	8 (19.05)	1(2.38)	3(7.14)	1(2.38)	6 (14.29)	17 (40.48)
χ^2	4.48	-	0.00	0.00	4.49	10.73
P price	0.034 [a]	1.000 [b]	1.000 [a]	1.000 [a]	0.034 [a]	0.001 [a]

Note: a: Chi-square test, b: Fisher exact

3.4 Comparison of therapeutic effects between laser group and stripping group

There was no statistical significance in the difference of recovery rate between laser group and stripping group (P>0.05) (see Table 5).

Table 5 Comparison of clinical efficacy between the two groups [n (%)]

group	recure	take a turn for the better	Not healed
Laser group (n = 42)	40(95.24)	2(4.76)	0(0.00)
Debridement group (n = 42)	39(92.86)	3(7.14)	0(0.00)
Z price	-0.458		
P price	0.647		

Note: Z: Mann-Whitney test

4. Discussion

Great saphenous vein varicose veins have a high incidence both domestically and internationally, ranging from 8% to 20% [7-8]. When the condition progresses severely, it can lead to varicose vein rupture, thrombophlebitis, and venous ulcers, affecting patients' quality of life to varying degrees. Lower limb angiography reveals that most patients with great saphenous vein varicose veins also have popliteal collateral branches, resulting in higher venous pressure and thus a tendency for tortuous venous clusters to form in the calf [9]. The traditional surgical approach is high ligation and stripping of the great saphenous vein, which, although widely recognized for its effectiveness, involves a long operation time, multiple incisions, and significant intraoperative bleeding. Postoperative complications such as subcutaneous hematoma due to vascular bed damage increase patient suffering [10]. Therefore, in recent years, clinical practices have continuously improved traditional techniques. Techniques like foam sclerotherapy for injection closure of varicose veins below the knee to reduce incisions and laser closure under ultrasound guidance can help mitigate these issues [11]. With advancements in treatment devices, minimally invasive procedures such as endovenous laser ablation (EVLT) and radiofrequency ablation (RFA) have been widely applied in the treatment of great saphenous vein varicose veins [12].

The principle of laser closure for varicose veins involves using the thermal effect of lasers to directly damage the venous wall at high temperatures. This process generates steam foam within the blood, which damages the endothelial cells of the vessel. The blood undergoes hypercoagulability and carbonization changes, leading to contraction of collagen fibers in the vessel. This promotes fibrosis and closure of the lumen, thereby achieving the goal of permanently closing the varicose vein [13-14]. Injecting sclerosing agents into the veins can destroy the endothelial cells of the venous vessels, forming clots, thus achieving the purpose of closing the venous vessels. Studies have shown that for reticular and branch varicose veins, injection with sclerosing agents can achieve good therapeutic effects and prognosis [15].

In this study, the main trunk of the great saphenous vein in patients was treated with either ring laser closure or high ligation and stripping. For the tortuous and dilated venous masses in the calf segment of the laser group, fine fiber optic coagulation was used after puncture. The stripping group adopted point-based stripping. For reticular venous dilation and small branch veins, foam sclerosing agent injection was used for closure. The results showed that the number of surgical incisions and intraoperative blood loss in the laser group were lower than those in the stripping group, with statistically significant differences, indicating that the laser group has more minimally invasive and aesthetically pleasing characteristics during surgery. Postoperative first-time ambulation time and hospital stay were shorter in the laser group compared to the stripping group, and the VAS score at 24 hours post-surgery was lower in the laser group than in the stripping group, with statistically

significant differences. This suggests that the laser closure procedure has advantages such as faster recovery and less pain compared to stripping surgery, consistent with previous foreign research results[16-17].

The VCSS scores of both groups were significantly lower three months post-surgery compared to pre-surgery, with statistically significant differences. Both surgical methods effectively improved the patients' clinical symptoms. During follow-up, intravenous ultrasound was used to assess whether there was any recurrence of GSV main trunk reflux. The results showed no statistically significant difference in clinical outcomes between the two groups, indicating that both endoscopic laser surgery and high ligation stripping are effective surgical methods for treating varicose veins of the great saphenous vein. In terms of complication rates, there was a clear difference in total complication rates between the laser group and the stripping group, primarily in subcutaneous hematoma and saphenous nerve injury. The cause of hematomas may be due to bleeding from branch vessels during the stripping of the great saphenous vein main trunk. The saphenous nerve, located adjacent to the great saphenous vein main trunk in the calf segment, is more prone to injury during surgery. In the laser closure group, precise injection of anesthetic swelling fluid under ultrasound guidance can effectively prevent thermal injury to the saphenous nerve. In contrast, in the stripping group, traction on the vascular bed or excessive stripping force during the removal of the main trunk might be a significant factor leading to injury of the saphenous nerve.

5. Conclusion

In summary, the clinical effect of endovenous laser closure surgery for treating varicose veins in the lower limbs is similar to that of high ligation and stripping surgery. However, endovenous treatment has a significantly lower incidence of subcutaneous hematoma and saphenous nerve injury compared to stripping surgery. It also offers advantages in postoperative patient experience and recovery speed, as well as fewer incisions and better aesthetics, making it clinically valuable for widespread application.

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