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Progress and Current Status of Treatment for Lower Limb Varicose Veins

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Abstract: ***Varicose veins of lower extremities are common venous diseases of lower extremities in clinic [1]. The total number of patients with varicose veins of lower extremities in China has exceeded 100 million, and the incidence rate is about 15% [2]. Therefore, there is a huge number of illnesses and a demand for surgical treatment. At present, the main treatment options for lower limb varicose veins include conservative treatment and surgical treatment. Surgical treatment methods include traditional surgery and minimally invasive surgery. The high ligation and stripping of the great saphenous vein has always been the gold standard for the treatment of lower limb varicose veins. This method is technically mature and clinically effective, but it is a destructive surgery that uses a stripping device to forcefully pull. Therefore, the intraoperative trauma is large, the amount of bleeding is high, and a series of postoperative complications such as hidden nerve damage, subcutaneous congestion, incision bleeding, deep vein thrombosis, etc. are prone to occur. With the increasing demand for skin aesthetics and reducing postoperative complications, minimally invasive surgery has gradually been applied to the treatment of lower limb varicose veins, such as intracavitary laser ablation, intracavitary radiofrequency ablation, Tri Vex minimally invasive rotary cutting, hemodynamic correction, etc. [3]. This article provides a review of the current main treatment methods for lower limb varicose veins, in order to further understand and master the principles and application scope of each treatment method, and to better select personalized treatment plans for varicose vein patients in the future.***

Keywords: Lower limb varicose veins, High ligation and stripping surgery, Minimally invasive treatment.

1. Introduction

Lower limb varicose veins belong to the category of chronic venous diseases and are one of the common and frequently occurring diseases in vascular surgery. The main clinical manifestation is the bulging of small leg venous clusters, which are more common in the great saphenous vein and can also be caused by various different diseases. The etiology includes genetic factors, long-term standing, heavy labor, etc. Its pathogenesis is poor elastic development of the venous wall, aging and dysfunction of the venous valve, and increased pressure in the superficial vein, which leads to long-term obstruction of the main venous blood flow, increased pressure in the distal venous vessels, thinning of the venous wall and enlargement of the lumen, causing local blood reflux and absorption disorders in subcutaneous tissue. At the same time, it triggers local inflammatory reactions, and then leads to tortuous dilation of the lower limb veins. The clinical manifestations of lower limb varicose veins mainly include subcutaneous cord like or clustered venous protrusions in the lower leg, weakness, heaviness, swelling, and pain in the affected limb; Physical examination shows that the superficial veins of the affected limb are tortuous and clustered, sometimes accompanied by skin pigmentation and wet dermatitis in the calf and boot areas. In severe cases, the skin may experience nutrient exchange disorders due to venous blood stasis, manifested as "old rotten legs" or skin ulceration and ulceration in the boot area. Skin ulcers in the boot area often remain untreated for a long time, and if left untreated, can lead to more serious complications such as infection, superficial thrombophlebitis, and even amputation, increasing the patient's medical burden, affecting their daily life, and resulting in a decline in their quality of life. The treatment methods for lower limb varicose veins include non-surgical treatment and surgical treatment. This article summarizes the current treatment methods for lower limb varicose veins, providing reference for future clinical and research work.

2. Non Surgical Treatment:

1) Pressure therapy: It is the basic treatment method for varicose veins in the lower limbs and can be applied to various stages of the disease, such as prevention and treatment. The main principle is to apply additional pressure to the affected limb through elastic socks or elastic bandages, thereby promoting venous return and reducing symptoms such as edema and fatigue caused by blood stasis in the affected limb. Due to its simplicity, non invasiveness, low cost, and reproducibility, pressure therapy is widely accepted and used by the vast majority of patients. For early patients with large saphenous vein varicose veins, pressure therapy can significantly improve their symptoms and is a necessary treatment measure after surgery, especially minimally invasive surgery. Pressure therapy also needs to be carried out under the guidance of a doctor. Incorrect or excessive pressure may cause pain and even tissue ischemic necrosis.

2) Medication therapy: The use of vasoactive drugs such as flavonoids, saponins, etc. The main principle of these drugs is to increase the tension of the venous vessel wall while reducing its permeability. By using this method, the blood volume in the veins can be reduced, the vascular pressure can be lowered, and related symptoms such as edema, pain, and fatigue caused by venous congestion in the lower limbs can be improved. Although intravenous active drugs have definite therapeutic effects, they need to be taken for a long time and cannot be reduced or stopped. Moreover, their efficacy is not as significant as other treatment methods, which can bring certain economic and psychological pressure to patients, and some patients have poor compliance. Drug therapy is currently an adjuvant therapy for pressure therapy, mainly

used for patients with mild symptoms.

3) foam sclerotherapy (UGFS): sclerotherapy is a minimally invasive treatment method that was earlier used to treat varices. Its main principle is to fully mix the liquid sclerosing agent (polycinnamol or polydocanol injection) and gas (air, carbon dioxide, etc.) in a certain proportion to form a foam, inject blood vessels to cause aseptic inflammation of the tube wall to damage the vein endothelium, and then fall off to form thrombus, leading to hypoxia of the vein wall and secondary inflammation, making granulation tissue fibrosis, closing the varices, and finally permanent closure [6]. Sclerotherapy is widely used in hospitals at all levels due to its simple operation, minimal patient pain, low cost, reproducibility, and good aesthetics. However, in the follow-up after surgery, the closure rate of UGFS was relatively low, and its efficacy was not as good as other surgical methods. Because the trunk of the great saphenous vein was not treated, the recurrence rate of simple foam sclerotherapy was very high [8]. Especially for patients with advanced great saphenous vein varicose veins, simple sclerotherapy alone cannot completely improve their symptoms, and is usually used as a supplementary method combined with surgical treatment.

3. Surgical Treatment:

3.1 Intraluminal Thermal Ablation

3.1.1 Endovascular laser ablation (EVLA)

Since its introduction, intracavitary laser therapy for varicose veins in the lower limbs has been widely used worldwide. EVLA technology uses a specific wavelength of laser to induce thrombosis and fibrosis throughout the superficial veins of the lower limbs through thermal effects, ultimately achieving the therapeutic goal of venous closure [9]. The success or failure of EVLA depends on the selection of optimal parameters, laser wavelength, fiber retraction speed, irradiation power, and other important factors that affect the laser closure effect. A large number of prospective analysis studies have verified the effectiveness of EVLA in treating lower limb varicose veins. The use of EVLA in the treatment of large saphenous vein dysfunction has a fast onset and significant therapeutic effect, with a 1-year occlusion rate of>90%, but the efficacy decreases over time [10]. The possible complications of EVLA include subcutaneous hematoma and bruising, skin burns, thrombophlebitis, skin sensory disorders, and deep vein thrombosis. Among them, lower limb deep vein thrombosis is the most severe, and the main reason may be thermal damage to the deep vein intima during laser ablation during surgery [11].

3.1.2 Intraluminal radiofrequency ablation (RFA)

Intraluminal radiofrequency ablation is also a commonly used treatment method that uses thermal effects to close the lumen. RFA uses the heat generated by the radiofrequency electrode catheter to directly act on the venous wall, causing damage to the venous endothelium and fibrosis closure of the venous vessels. Compared with EVLA, RFA's radiofrequency catheter can maintain a constant temperature and a constant heating closure time during operation, resulting in uniform heating of the venous intima. It has the characteristics of moderate thermal penetration, easy regulation of thermal coagulation range, relatively fewer side effects, and fast postoperative recovery. A multicenter study on EVLA, RFA, and traditional exfoliation showed that postoperative traditional exfoliation.

3.1.3 Endovascular microwave ablation (EMA)

Endovascular microwave ablation is a new minimally invasive thermal ablation method for the treatment of lower limb varicose veins. The principle is that the heat generated by the microwave catheter directly and uniformly acts on the venous lumen and vascular wall, causing occlusion of the venous wall lumen through thermal damage. Microwave thermal ablation has the characteristics of fast heating, high thermal efficiency, moderate thermal penetration, uniform tissue heating, and easy control of thermal solidification range [13]. A study has shown that EMA has a lower incidence of skin burns, skin bruising, and skin sensory disorders than EVLT while ensuring the closure rate of the great saphenous vein [14]. Another study showed that the venous closure rate after EMA surgery for 3 years was about 79.8%, but the incidence of limb numbness after surgery was as high as 32.1% [15]. From this, it can be seen that the clinical efficacy of EMA still needs to be verified. Currently, there is no large-scale application of this surgical method to treat varicose veins in China. However, based on the comprehensive results of existing reports at home and abroad, EMA is a safe and effective minimally invasive method for treating varicose veins. This surgical method still has certain development prospects. Currently, there are few randomized controlled studies on EMA, and more research is needed to ensure its long-term efficacy.

3.2 Non Intracavity Thermal Ablation

3.2.1 Hemodynamic correction surgery (Cure Conservatlve et Hemo dynamique de l'Insuffisance Veineuse en Ambulatoire, CHIVA)

Hemodynamic correction (CHIVA) is a surgical approach primarily based on hemodynamic treatment for varicose veins of the great saphenous vein. The premise of this surgical method is to conduct a correct hemodynamic evaluation, usually using Doppler ultrasound, with the aim of restoring normal hemodynamics to the lower limb blood vessels. CHIVA uses subcutaneous injection of 1% lidocaine for local anesthesia, which eliminates venous hypertension by ligating and disconnecting the saphenous vein and refluxing perforating vein in close proximity to the deep vein, and removing 4cm or 5cm of the distal vessel; Perform point stripping surgery on secondary veins without drainage function, preserving the main trunk of the great saphenous vein and normally functioning perforating veins [16]. This procedure uses ultrasound to locate the source of lower limb venous hypertension and ligate the site to reduce blood reflux, thereby lowering lower limb vascular pressure and relieving symptoms. Due to the difficulty in evaluating hemodynamics and the high requirement for the surgeon's ultrasound level, its widespread application is difficult to achieve. CHIVA treatment for lower limb venous insufficiency can preserve the main vein of the great saphenous vein, which has the advantages of less surgical trauma, faster postoperative

recovery, and lower incidence of complications compared to other surgeries. However, due to the untreated main vein of the great saphenous vein, the second surgical intervention rate is high.

3.2.2 Tri Vex Minimally Invasive Circumcision (TIMIC)

Under the guidance of a cold light source, a small incision is made on the skin. Anesthetic swelling solution is injected subcutaneously, and the rotary cutting blade is placed on the affected vein while suctioning [17]. The biggest advantage of this procedure is that it can treat clustered varicose veins and superficial vein thrombosis that cannot be treated by other minimally invasive treatment techniques. Due to the ability to operate under direct vision with a cold light source, the treatment is more thorough, with advantages such as small incisions and relatively thorough treatment [18]. Some scholars also believe that even in small incisions, mechanical damage during subcutaneous rotary cutting is still significant, which may cause sensory nerve and lymphatic trauma. Postoperative skin sensory abnormalities, subcutaneous bruising, and incision infection complications are more common. It can be applied to treat patients with large lesions of venous masses and superficial venous thrombosis that cannot be treated by other minimally invasive methods, but it needs to be combined with other minimally invasive techniques to ensure efficacy. Due to the need for lumbar epidural anesthesia, patients are unable to walk immediately after surgery, which increases the risk of deep vein thrombosis [19].

4. Summary

Lower limb varicose veins, as a common disease of lower limb veins, surgical treatment is an important method to remove the cause, prevent the condition from worsening, and improve the quality of life of patients. The traditional high ligation and stripping of the great saphenous vein has become an important surgical technique that cannot be ignored due to its precise clinical efficacy and relatively low diagnosis and treatment costs. With the continuous improvement of people's requirements for reducing surgical trauma and skin beauty, minimally invasive surgery has gradually become the main treatment method. Laser ablation and radiofrequency ablation have clear clinical efficacy for the main trunk of the great saphenous vein, but there is a lack of certain efficacy in the treatment of perforating branches, small branches, and local recurrence of venous curvature; Foam hardener is more respected because of its safety, effectiveness and convenience. However, single use of foam hardener lacks certain therapeutic effect, can not effectively remove the cause of disease, and has problems related to high recurrence rate; Other treatment methods such as hemodynamic correction surgery and Tri Vex minimally invasive rotary cutting surgery have been less developed clinically due to a lack of extensive clinical trial data to prove their long-term efficacy and high requirements for the surgeon's ultrasound level; In summary, in practical clinical applications, various technical advantages and disadvantages, safety, indications, and patient preferences should be comprehensively considered, and hospital facilities and technology should be taken into account from multiple aspects. While strictly following surgical indications, personalized diagnosis and treatment plans should be developed to improve patient satisfaction. At present, the treatment of primary lower limb varicose veins has shifted from using a single surgical procedure to a combination surgery tailored to the patient's disease etiology, severity, and economic level. Therefore, the current main issue is which combination surgical approach can more efficiently treat primary lower limb varicose veins, reduce postoperative recovery time and complications, and improve patients' quality of life.

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