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Review

# A Systemic Review on Management and Treatment of Varicose Vein

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**Abstract:**
Varicose veins, a prevalent vascular condition characterized by enlarged and twisted veins visible beneath the skin's surface, stem from compromised vein valves that lead to inefficient blood flow, pooling, and heightened venous pressure. This comprehensive review explores the diverse array of treatment options available for varicose veins. It covers conservative measures such as lifestyle modifications and compression therapy, which aim to alleviate symptoms and prevent progression. Additionally, the review delves into minimally invasive procedures like sclerotherapy and endovenous thermal ablation, which offer targeted closure of affected veins with minimal discomfort and rapid recovery times. Surgical interventions such as high ligation and vein stripping are also discussed, providing effective solutions for more severe cases. Each treatment modality's efficacy, benefits, and potential complications are critically evaluated, offering healthcare providers a balanced perspective to guide individualized treatment plans and optimize patient outcomes.

**Keywords**: Varicose vein, endovenous treatment, Conservative treatments, Lifestyle changes, Compression stockings, Sclerotherapy



## Introduction

Varicose veins are a common vascular condition that affects a significant portion of the population, particularly women and older adults [1]. These enlarged, twisted veins can appear blue or dark purple and often occur in the legs and feet. Beyond their impact on appearance, varicose veins can cause various symptoms affecting quality of life. Individuals may experience pain, aching, swelling, a feeling of heaviness, and muscle cramping in the legs [2,3]. In more severe cases, varicose veins can lead to complications such as skin changes, inflammation (phlebitis), bleeding, and the development of venous ulcers, which are painful sores that can be difficult to heal. The pathophysiology of varicose veins primarily involves venous hypertension resulting from valve incompetence within the veins [4]. Normally, veins contain one-way valves that prevent blood from flowing backward as it returns to the heart. When these valves become weakened or damaged, blood can pool in the veins, causing them to enlarge and become tortuous [5].

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This venous insufficiency can be influenced by various factors, including genetic predisposition, hormonal changes, prolonged standing or sitting, obesity, pregnancy, and advancing age.

Addressing varicose veins involves a multifaceted approach. Various treatment options are available, ranging from conservative measures to more advanced medical interventions [6,7]. Lifestyle modifications, such as regular exercise, weight management, and elevating the legs, can help alleviate symptoms and prevent worsening of the condition. Compression therapy, which involves wearing specially designed stockings that apply pressure to the legs, can improve blood flow and reduce discomfort [8].

For those with more severe varicose veins or when conservative treatments are insufficient, medical and surgical options are considered. These include sclerotherapy, laser therapy, radiofrequency ablation, endovenous laser treatment (EVLT), and surgical procedures like vein stripping and ligation. Each treatment has its own set of advantages and disadvantages, which are important to consider when developing a patient-specific management plan [10].

This article aims to review the current evidence and guidelines for the treatment of varicose veins, providing a detailed analysis of the advantages and disadvantages of each approach. By exploring the efficacy, safety, and patient outcomes associated with these treatments, we aim to offer comprehensive insights that can aid healthcare providers in making informed decisions and improving patient care [15,16].

**Conservative Treatments:**

Conservative treatments for varicose veins primarily focus on alleviating symptoms and preventing further progression of the condition without resorting to invasive procedures [11,12]. These measures include lifestyle modifications, such as regular exercise, maintaining a healthy weight, and avoiding prolonged periods of standing or sitting, which can exacerbate venous pressure in the legs. Elevating the legs while resting can also help reduce swelling and improve blood flow [13]. Compression therapy is a cornerstone of conservative management, involving the use of specially designed compression stockings that apply graduated pressure to the legs, thereby enhancing venous return and decreasing venous stasis [14]. These stockings come in various compression levels and should be properly fitted to ensure effectiveness. Additionally, patients are often advised to follow a diet rich in flavonoids and antioxidants, which may support vascular health [15]. While conservative treatments do not eliminate varicose veins, they play a crucial role in symptom management and can be particularly beneficial for individuals with mild to moderate cases or those who are not candidates for more invasive interventions [20].

***Lifestyle Modifications***

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Lifestyle changes are often the first-line treatment for varicose veins, particularly in mild cases or when used in conjunction with other therapies [28]. These include maintaining a healthy weight to reduce pressure on the veins, engaging in regular physical activity to improve circulation, and avoiding prolonged periods of standing or sitting which can exacerbate venous pressure. Elevating the legs when resting can help decrease swelling and promote blood flow [29]. Wearing loose clothing and avoiding high heels can also aid in reducing venous pressure and improving overall leg health. Additionally, dietary modifications to include foods rich in fiber and low in salt can prevent constipation and reduce leg swelling, further alleviating symptoms of varicose veins [30].

**Pros**:

- Non-invasive [5]
- Cost-effective [7]
- Improves overall cardiovascular health [5]

**Cons**:

- Limited effectiveness for advanced varicose veins
- Requires patient adherence and lifestyle changes [7]

**Compression Therapy:**

**Compression stockings**

Compression stockings are a cornerstone of conservative treatment for varicose veins, designed to apply graduated pressure to the legs, promoting venous return and reducing symptoms [31]. These stockings exert the highest pressure at the ankle, gradually decreasing up the leg, which helps to improve blood flow and reduce venous stasis. By compressing the superficial veins, they minimize swelling, alleviate pain, and prevent the progression of vein dilation [32]. Compression stockings are available in various strengths and styles, tailored to meet the specific needs of patients [33]. Proper fitting by a healthcare professional is essential to ensure optimal effectiveness and comfort, making them a practical and widely recommended option for managing varicose veins conservatively [35].

**Types of Compression Stockings:**

1. **Gradient Compression Stockings**: Apply the highest pressure at the ankle and gradually decrease up the leg [65].
2. **Custom-Fitted Stockings**: Tailored to fit the patient's measurements, providing optimal compression [64].

**Pros**:

- Non-invasive
- Can reduce symptoms and prevent worsening [45]
- Useful as adjunct therapy post-procedure [40]

**Cons** :

- Does not eliminate existing varicose veins [66]
- Can be uncomfortable, especially in warm weather
- Requires regular use for effectiveness [89].

**Minimally Invasive Treatments:** Sclerotherapy

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Sclerotherapy involves injecting a sclerosant solution directly into the varicose vein, causing it to irritate the vein's inner lining, leading to its collapse and eventual reabsorption by the body [90]. This procedure effectively seals off the treated vein, redirecting blood flow to healthier veins and reducing the appearance and symptoms of varicose veins [91]. The treatment is typically performed in a doctor's office and requires no anesthesia, making it a convenient option for many patients [92]. Multiple sessions may be necessary to achieve optimal results, particularly for larger veins. Sclerotherapy is highly effective for small to medium-sized varicose veins and spider veins, offering a minimally invasive alternative to surgical treatments [93].

**Types of Sclerotherapy:**

1. **Liquid Sclerotherapy**: Liquid sclerotherapy involves injecting a liquid sclerosant solution into small to medium-sized varicose veins, causing them to collapse and be reabsorbed by the body [94]. It is effective for treating spider veins and smaller varicose veins with minimal discomfort.

2. **Foam Sclerotherapy**: Foam sclerotherapy uses a foamed sclerosant solution, which is injected into larger varicose veins, allowing for better vein contact and improved efficacy. The foam displaces blood within the vein, promoting vein collapse and absorption [96].

**Pros**:

- Effective for small to medium-sized veins [97].
- Outpatient procedure with minimal downtime [98].
- Relatively low cost [99].

**Cons**:

- Multiple sessions may be needed [100].
- Possible side effects include hyperpigmentation and matting [101].
- Risk of allergic reactions to the sclerosant [102].

***Endovenous Thermal Ablation:***

Endovenous thermal ablation is a minimally invasive procedure used to treat larger varicose veins by applying thermal energy to the vein's interior [103]. This technique involves inserting a thin catheter into the affected vein, through which either laser (endovenous laser treatment) or radiofrequency energy is delivered [104]. The heat generated by these energy sources causes the vein walls to collapse and seal shut, rerouting blood flow to healthier veins [105]. The procedure is typically performed under local anesthesia and guided by ultrasound, ensuring precision and safety. Endovenous thermal ablation offers a high success rate, minimal recovery time, and reduced postoperative pain compared to traditional surgical methods, making it a preferred option for many patients [106].

**EVLA and RFA**:

- **EVLA**: Uses laser energy to heat and seal the vein [107].

- **RFA**: Uses radiofrequency energy to achieve the same effect [109].

**Pros**:

- High success rates [110].
- Minimally invasive with local anesthesia [111].
- Quick recovery time [112].

**Cons**:

- May cause temporary bruising, swelling, and nerve irritation
- Requires specialized equipment and training
- Slight risk of vein perforation or thermal injury to surrounding tissues [113,114].

***Non-Thermal, Non-Tumescent (NTNT) Procedures***

Non-thermal, non-tumescent (NTNT) procedures like mechanochemical ablation (MOCA) and cyanoacrylate adhesive closure provide alternative methods to close varicose veins without using heat or tumescent anesthesia [115]. MOCA involves combining mechanical disruption of the vein endothelium with the infusion of a sclerosant solution, promoting closure and subsequent reabsorption of the treated vein [116]. On the other hand, cyanoacrylate adhesive closure utilizes a medical adhesive to seal the vein shut, effectively redirecting blood flow [117]. These procedures are typically performed under local anesthesia and offer benefits such as faster recovery times and reduced discomfort compared to traditional thermal ablation techniques, making them increasingly popular choices for treating varicose veins [118, 119].

**Mechanochemical Ablation (MOCA)**:

- Combines mechanical disruption of the vein wall with a sclerosant.

**Cyanoacrylate Adhesive Closure**:

- Uses a medical adhesive to seal the vein.

**Pros**:

- No need for tumescent anesthesia
- Reduced risk of nerve injury
- Effective for various vein sizes [120]

**Cons**:

- Limited long-term data
- Potential for allergic reactions to adhesive
- Requires specialized equipment [121, 122].

**Surgical Treatments :**

***High Ligation and Stripping***

High ligation involves tying off the varicose vein near its connection to the deeper veins, effectively cutting off blood flow to the affected vein [123]. Stripping, on the other hand, involves physically removing the varicose vein through small incisions made along its path. While these surgical methods have historically been effective, they are now less commonly performed due to advancements in less invasive techniques like endovenous thermal ablation and sclerotherapy [124,125]. However, high ligation and stripping may still be considered in specific cases where other treatments are not suitable or when the varicose veins are extensive or recurrent [126]. These procedures are typically performed under general or regional anesthesia and require a longer recovery period compared to minimally invasive options [127,128].

**Pros**:

- Effective for large, symptomatic veins
- Long track record of success [129,135]

**Cons**:

- Invasive with longer recovery time
- Higher risk of complications like infection and nerve injury
- Requires general or spinal anesthesia [130].

***Ambulatory Phlebectomy***

Ambulatory phlebectomy is a minimally invasive procedure used to physically remove superficial varicose veins through tiny skin punctures, typically performed under local anesthesia. During the procedure, small incisions are made over the course of the varicose vein, and the vein segments are carefully extracted using specialized hooks or forceps

[131,132]. This method is particularly effective for treating bulging varicose veins close to the skin surface, offering immediate cosmetic improvement and relief from associated symptoms like pain and swelling [133]. Ambulatory phlebectomy is considered safe and is often preferred for patients who are not suitable candidates for other minimally invasive techniques or who have varicose veins that do not respond adequately to sclerotherapy or thermal ablation [134]. Recovery is usually quick, with minimal scarring and discomfort compared to traditional surgical methods.

**Pros**:

- Effective for superficial veins
- Minimal scarring and quick recovery
- Can be combined with other procedures [50,135]

**Cons**:

- Limited to accessible veins close to the skin surface
- May require multiple sessions for extensive varicose veins
- Potential for minor bleeding and bruising [55].

**Comparison of Treatment Modalities**

When comparing treatment options for varicose veins, it's essential to evaluate several factors. The severity and specific location of the varicose veins play a crucial role in determining the most suitable approach. Patient preferences regarding invasiveness [56,57], recovery time, and cosmetic outcomes also weigh heavily in decision-making. Additionally, healthcare providers consider the potential risks associated with each treatment, such as allergic reactions, nerve injury, or recurrence of varicose veins, balanced against the benefits like symptom relief, improved circulation, and enhanced quality of life [58]. A comprehensive assessment ensures that the chosen treatment aligns with the individual patient's needs and goals, optimizing outcomes and satisfaction.

**Efficacy**:

- Endovenous thermal ablation and sclerotherapy are recognized for their high success rates in treating varicose veins, especially when tailored to the specific characteristics of the veins being treated. Endovenous thermal ablation, whether using laser or radiofrequency energy, delivers precise heat to the vein wall, causing it to collapse and eventually be reabsorbed by the body [59,60]. This technique is particularly effective for larger veins and offers lasting closure with minimal discomfort and a short recovery period. On the other hand, sclerotherapy involves injecting a sclerosant solution directly into the varicose vein, leading to inflammation and closure of the vein [61]. It is highly effective for smaller to medium-sized veins, including spider veins, and can significantly improve both cosmetic appearance and symptoms like pain and swelling [62,63]. Both treatments are outpatient procedures performed under local anesthesia, making them convenient and preferred options for many patients seeking relief from varicose vein symptoms while achieving satisfactory cosmetic outcomes [64].
- Surgical treatments continue to be effective options for managing larger, symptomatic varicose veins that may not be suitable for minimally invasive techniques [65]. Procedures like high ligation and vein stripping involve physically tying off or removing the affected vein through small incisions. These methods are particularly beneficial when varicose veins are extensive, causing significant discomfort or complications such as skin changes or ulcers [66]. While less commonly performed today due to advancements in minimally invasive procedures like endovenous thermal ablation and sclerotherapy, surgical treatments still play a critical role in certain cases where these less invasive options may not provide sufficient relief or when there are specific anatomical considerations [67,68]. Surgical interventions are typically performed under general or regional anesthesia and may require a longer recovery period compared to non-surgical approaches, but they remain highly effective in addressing severe varicose vein symptoms and improving overall vascular health [69].

**Recovery Time**:

- Minimally invasive procedures offer quicker recovery and less downtime compared to surgery [70].

**Complications**:

- Conservative treatments, such as lifestyle modifications and compression therapy, are associated with minimal risks and side effects, making them suitable initial options for managing varicose veins, especially in mild to moderate cases [71]. These approaches focus on alleviating symptoms like pain and swelling, improving circulation, and preventing further progression of the condition. However, for severe varicose veins characterized by extensive dilation, significant discomfort, or complications like venous ulcers, conservative treatments may offer limited relief [72]. In such cases, more invasive interventions like endovenous thermal ablation, sclerotherapy, or surgical procedures may be necessary to achieve optimal outcomes [74]. It's important for healthcare providers to assess the severity of varicose veins and tailor treatment plans accordingly to ensure effective symptom management and prevent potential complications [75,76].
- Minimally invasive procedures for treating varicose veins, such as endovenous thermal ablation and sclerotherapy, are known for their reduced complication rates in comparison to traditional surgical methods [77]. These techniques involve less trauma to surrounding tissues, leading to quicker recovery times and lower risk of postoperative complications such as infection or nerve damage [78,79]. However, performing these procedures requires specialized skills and equipment, including ultrasound guidance for precise placement of catheters or injections [80]. Healthcare providers trained in vascular interventions must ensure proper patient selection and technique to achieve optimal outcomes while minimizing risks. Despite these requirements, the advantages of minimally invasive procedures often outweigh the potential challenges, offering patients effective treatment options with enhanced safety and comfort [81].

**Cost**:

- Conservative treatments and sclerotherapy are generally less expensive than surgical options [82].
- Endovenous thermal ablation and NTNT procedures may involve higher upfront costs but are cost-effective in the long term due to reduced recurrence rates and recovery time [83].

## Conclusion

The treatment landscape for varicose veins has undergone profound evolution, now encompassing a spectrum that spans from conservative approaches to cutting-edge minimally invasive techniques and surgical interventions [83]. This diversity allows healthcare providers to tailor treatment plans to each patient's unique clinical characteristics, personal preferences, and the expertise available. Conservative management, such as lifestyle adjustments and compression therapy, provides a non-invasive starting point to alleviate symptoms and prevent progression. For more complex cases, advanced procedures like endovenous thermal ablation and sclerotherapy offer targeted closure of affected veins with minimal discomfort and rapid recovery times [84,85]. Surgical interventions like high ligation and vein stripping remain effective for severe or extensive varicose veins that require more aggressive treatment [87].

The decision-making process involves a thorough consideration of the benefits and potential drawbacks of each treatment option, ensuring that patients receive comprehensive care aligned with their goals for symptom relief and cosmetic improvement. Ongoing research and technological advancements continue to refine these approaches, promising enhanced efficacy, safety, and patient outcomes in the future [88]. By staying informed of the latest developments and collaborating closely with patients, clinicians can optimize treatment strategies and contribute to improving both the management of

varicose veins and the overall quality of life for individuals affected by this condition [90].

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