

A Review: A Systematic-Review and Meta-Analysis of the Treatment of Varicose Veins

**Miss. Aishwarya Laxmikant Shrirao^{*1}, Miss. Pooja Dilip Chahande²,
Miss Divyani Pramod Masurkar³ Mr. Vicky Dilip Gajbhiye⁴, Miss. Vijaya Narendra Pandhare⁵**

¹M-PHARM, ^{2,3,4}B. Pharm Student

New Montfort Institute of Pharmacy, Ashti, Wardha

shriraoaishwarya6898@gmail.com¹ chahandepooja6@gmail.com² divyanimasurkar2003@gmail.com³

vickygajbhiye231@gmail.com⁴ vijayapandhare005@gmail.com⁵

Abstract: Varicose veins are a common manifestation of chronic venous insufficiency and can lead to pain, swelling, skin changes, and ulceration. This systematic review and meta-analysis evaluates the effectiveness and safety of major treatment modalities for varicose veins, including surgery (ligation and stripping), endovenous thermal ablation (laser and radiofrequency), foam and liquid sclerotherapy, and emerging minimally invasive procedures. A comprehensive search of published randomized controlled trials and observational studies was performed to compare outcomes such as symptom improvement, vein occlusion rates, recurrence, complications, and patient satisfaction. Results indicate that endovenous thermal ablation demonstrates high occlusion rates and faster recovery with fewer complications compared to conventional surgery. Foam sclerotherapy is effective for smaller veins but has higher recurrence rates over long-term follow-up. Surgical treatment remains useful for extensive or recurrent varicosities but is associated with longer recovery time.

Keywords: Varicose Veins, Chronic Venous Insufficiency, Endovenous Laser Ablation (EVLA), Radiofrequency Ablation (RFA), Sclerotherapy, Foam Sclerotherapy, Surgical Ligation and Stripping, Treatment Efficacy.

I. INTRODUCTION

Varicose veins:

Varicose veins are enlarged and tortuous veins. They are part of the chronic venous insufficiency syndrome and are associated with complications such as edema, skin pigmentation, lower-limb ulcers, thrombophlebitis and bleeding. Primary varicose vein disease is a widely prevalent condition. It affects about 10–40% of 30–70-year-old people. Varicose veins were regarded as a Secondary manifestation of valvular incompetence and exposure of the vein wall to pressures that it cannot withstand, i.e. the hydro static head of pressure from the right auricle in the upright position.[1] Widened veins in the subcutaneous tissues of the legs and are often easily visible. Their valves are usually incompetent so that reflux of blood occurs, and the resulting venous hypertension can cause symptoms. Varicose veins are widely seen as medically unit and deserving low priority for treatment. However, they cause concern and distressing large scale. [2]



Fig. varicose veins [3]



Varicose veins are one of a number of symptoms associated with chronic venous insufficiency and chronic venous disease. Chronic venous insufficiency occurs when the venous wall and/or valves in the leg veins are not working effectively, causing blood to collect in the veins, usually present in lower limbs. Varicose veins cause symptoms such as throbbing pain, aching swelling, cramping, itching and bleeding. Varicose veins associated symptoms, and consequential restrictions on the ability to walk and stand, can have a substantial impact on patient quality of life. An estimated 30% of people with varicose veins will develop skin changes such as eczema, edema and skin discoloration, associated with chronic venous insufficiency. [4]

Varicose veins can be treated conservatively, through the use of compression hosiery and lifestyle advice. Compression therapy does not actively treat CVD, it is used to manage symptoms such as swelling, heaviness and pain, and to help blood flow and venous return, thus slowing disease progression. Patients should also receive advice regarding weight, lifestyle, measures to prevent symptoms of varicose veins: worsening such as elevating legs, and the importance of skin care. [5]

II. PATHOPHYSIOLOGY

Venous hypertension, venous valvular incompetence, structural changes in the vein wall, inflammation, and alterations in shear stress are the major pathophysiological mechanisms resulting in varicose veins.

III. RISK FACTORS OF VARICOSE VEINS

Risk factors for varicose veins can be categorized as hormonal, lifestyle, acquired, and inherited (Table 1).

The effect of estrogen on the risk of varicose veins may explain, in part, the increased prevalence among women. Smoking is an important modifiable risk factor for varicose veins and more severe forms of chronic venous disease, including venous ulceration.

Post-thrombotic syndrome after deep vein thrombosis (DVT) may result in varicose veins in the absence of primary venous disease.

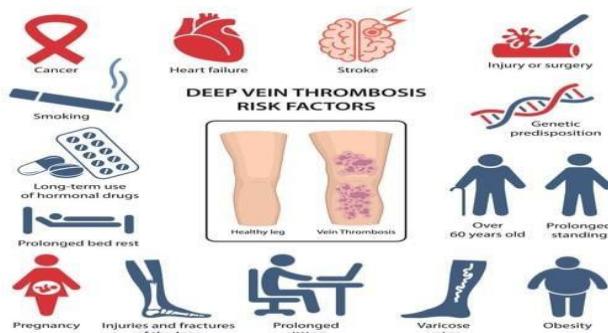


Fig. Risk factors of varicose veins. [6]

Category	Risk Factor	Proposed Mechanism
Hormonal	Female gender	High estrogen state
	Prolonged standing and/or sitting	Venous hypertension
Lifestyle	Smoking	Venous endothelial injury
	Obesity	Venous hypertension
	Pregnancy	High estrogen state Venous hypertension
Acquired	Deep vein thrombosis	Deep venous obstruction Venous valvular incompetence
	Age	Venous valvular incompetence
	Family history	Venous valvular incompetence
Inherited	Tall height	Venous hypertension
	Congenital syndromes	Venous valvular incompetence Venous hypertension Deep venous



	obstruction
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Table 1. Risk Factors for Varicose Veins. [7]

IV. SYMPTOMS OF VARICOSE VEINS

Descriptions of pain, heaviness and itching were common to participants in all three studies with swelling reported in only two papers. Cramps, tingling and numbness were also reported as troublesome symptoms reflecting the broad range of physical symptoms described across the three papers. The symptoms often had an impact on other aspects of life, such as sleep, resulting in participants feeling tired. The distress associated with symptoms is clearly described by some study participants, whilst for others the symptoms were less troubling.

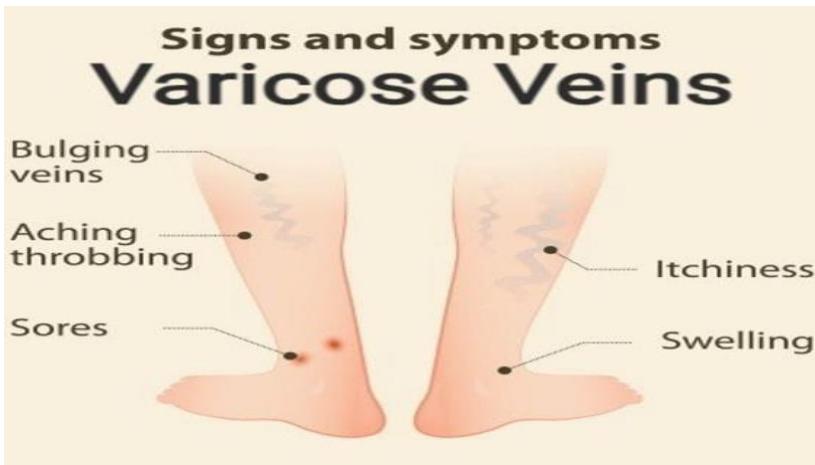


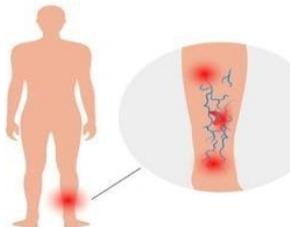
Fig Symptoms of varicose veins. [8]

V. CAUSES OF VARICOSE VEINS

Varicose veins occur when the veins become enlarged, twisted, and overfilled with blood due to problems with blood flow.

The main cause is weak or damaged valves inside the veins.

Causes of Varicose Veins



- Genetic predisposition
- Prolonged standing and sitting
- Unbalanced diet
- Tight clothing
- Uncomfortable shoes
- Large exercise
- Hormonal imbalance
- Obesity
- Pregnancy

Fig. Causes of varicose veins. [9]

1. Primary Causes: These are due to inherent weakness or malfunction of the vein wall or valves, without any other underlying disease.

- Valve incompetence (Venous reflux): The most common cause — valves fail to close properly, allowing blood to flow backward.
- Weakness in the vein wall: Congenital or acquired weakness makes veins dilate and valves become incompetent.
- Genetic predisposition: A strong family history is often seen.

2. Secondary Causes (Due to Other Conditions):

These occur when another condition increases venous pressure or damages the veins.

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- Deep vein thrombosis (DVT): Previous clots can damage valves and obstruct venous return.
- Arteriovenous fistula: An abnormal connection between artery and vein increases venous pressure.
- Pelvic tumors or masses: Can compress veins and obstruct blood flow.
- Pregnancy: The growing uterus increases pressure in pelvic and leg veins; hormonal changes also weaken vein walls.

3. Other causes:

- Valve incompetence → Blood reflux.
- Venous hypertension → Increased pressure within superficial veins.
- Vein wall dilation → further separation of valve cusps.
- Venous stasis → pooling of blood and visible varicosities.[10]

VI. DIAGNOSIS OF VARICOSE VEINS

Accurate diagnosis of varicose veins is essential for selecting appropriate treatment options and evaluating outcomes in clinical studies. The diagnostic process typically includes clinical examination, non-invasive imaging, and classification systems that assess disease severity.

1. Clinical Evaluation

- History taking: Patients are asked about leg pain, heaviness, swelling, itching, night cramps, prolonged standing, and family history.
- Physical examination: Inspection and palpation of the legs in the standing position to identify:
 1. Dilated, tortuous superficial veins
 2. Skin changes (hyperpigmentation, eczema, lipodermatosclerosis)
 3. Ankle edema
 4. Active or healed venous ulcers

2. Duplex Ultrasound (DUS) – Gold Standard

Duplex ultrasound is considered the primary diagnostic tool for varicose veins. It provides:

- Anatomical information: Identifies affected veins (great saphenous, small saphenous, perforators).
- Functional assessment: Detects venous reflux (>0.5 seconds), obstruction, and valve incompetence.
- Mapping: Helps plan treatment by mapping reflux sources such as:
 1. Saphenofemoral junction (SFJ) incompetence
 2. Saphenopopliteal junction (SPJ) incompetence
 3. Perforator incompetence

3. Classification Systems

CEAP Classification

Widely used in research and clinical practice to classify chronic venous disease:

- C – Clinical: C0–C6 (from no visible signs to active ulcer)
- E – Etiologic: Congenital, primary, secondary
- A – Anatomic: Superficial, deep, perforator veins
- P – Pathophysiologic: Reflux, obstruction, or both

This system ensures uniform reporting in systematic reviews and meta-analyses.

VCSS (Venous Clinical Severity Score)

Used to measure disease severity and treatment outcomes based on:

- Pain
- Varicosities
- Edema
- Pigmentation



- Inflammation
- Induration
- Ulcer characteristics

4. Additional Tests (Rarely Needed)

- Photoplethysmography (PPG) – Assesses venous refill time
- Venography – Invasive and used only in complex cases
- Air Plethysmography – Measures venous function

5. Diagnostic Importance in Systematic Reviews

In a systematic review of varicose vein treatments, diagnosis plays a crucial role in:

- Selecting appropriate studies based on consistent diagnostic criteria
- Ensuring comparability of patient populations
- Interpreting treatment effect depending on disease severity.[11]

VII. RESULT

Systematic reviews and meta-analyses show that traditional surgery has low-quality evidence for long-term efficacy, while minimally invasive treatments like radiofrequency ablation (RFA) and endovenous laser ablation (EVLA) have short-term effectiveness with less pain and faster recovery. Some studies suggest that endovenous treatments are as safe and effective as surgery, and sclerotherapy is a valuable option, especially for smaller veins. The best treatment depends on the specific type of varicose vein.

VIII. DISCUSSION

Very low quality evidence suggests that the available treatments for varicose veins (surgery, sclerotherapy, foam therapy, laser endoluminal ablation and radiofrequency endoluminal ablation) appear to be safe with rare side effects.

All modern treatments for varicose veins are safe with low risk of serious complications.

- Endovenous laser and radiofrequency ablation are the safest and most effective for long-term results.
- Surgery is effective but has more postoperative discomfort and wound-related side effects.
- Sclerotherapy is very safe for small or medium veins but may need multiple sessions and has higher recurrence.

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