



**ORIGINAL RESEARCH PAPER**

**General Surgery**

**SURGICAL APPROACH TO VARICOSE VEINS**

**KEY WORDS:** Varicose veins, minimally invasive techniques, compression therapy, Endovenous thermal ablation, venous hypertension, neovascularisation, Superficial venous reflux

<b>Dr. Uzmasultana Mulla</b>	Jr2, Department of General Surgery, Al-Ameen Medical College Hospital, Vijayapura.
<b>Dr. Jilani Awati</b>	Professor, Department of General Surgery, Al-Ameen Medical College Hospital, Vijayapura.
<b>Dr Vipul Mittal</b>	Jr3, Department of General Surgery, Al-Ameen Medical College Hospital, Vijayapura.

**INTRODUCTION**

Varicose veins, defined as pathologically dilated and twisted superficial veins, arise from chronic venous hypertension secondary to valvular dysfunction or impaired venous return. Globally affecting an estimated 20-30% of adults, the condition exhibits a higher prevalence in women, aging populations, and individuals with risk factors such as obesity, genetic predisposition, or prolonged standing. Beyond their visible appearance, varicose veins pose significant clinical burdens, including pain, chronic limb swelling, and skin changes that may progress to venous ulcers, recurrent superficial thrombophlebitis, or rare but serious hemorrhage. These complications often diminish mobility, disrupt daily activities, and increase healthcare utilization for chronic wound management. Surgical intervention is typically reserved for patients<sup>1</sup> unresponsive to conservative therapies—such as compression stockings, elevation, or pharmacologic agents—or those with severe symptoms, advanced disease (e.g., non-healing ulcers), or recurrent thrombotic events. The decision to pursue surgery balances clinical severity, anatomical involvement, and patient-specific goals, prioritizing symptom relief, functional improvement, and prevention of long-term morbidity.

**Pathogenesis:**

- Valve incompetence: Primary cause of retrograde flow (reflux), leading to blood pooling.
- Venous hypertension: Elevated pressure damages vessel walls, causing dilation and tortuosity.
- Wall remodeling: Chronic stress triggers inflammation, smooth muscle hypertrophy, and extracellular matrix degradation.

**Risk Factors:**

- Age: Reduced vein elasticity and valve integrity over time.
- Genetics: Familial predisposition to weak venous walls/valves.
- Obesity: Increased intra-abdominal pressure impairs venous return.
- Pregnancy: Hormonal changes and uterine pressure on pelvic veins.
- Prolonged standing: Limits calf muscle pump efficiency, worsening venous stasis.

**Patient Evaluation**

**1. Clinical Assessment:**

**Symptom History:**

Elicit details of pain (aching, heaviness), swelling (worsening with activity), and pruritus.

Document triggers (prolonged standing) and alleviating factors (elevation).

**Physical Signs:**

Inspect for edema, varicosities, skin changes (hyperpigmentation, lipodermatosclerosis).

Palpate for tenderness, cord-like thrombosed veins, or ulceration.

**2. Diagnostic Tools:**

**Duplex Ultrasound:**

Assess venous reflux duration (>0.5 seconds indicates incompetence).

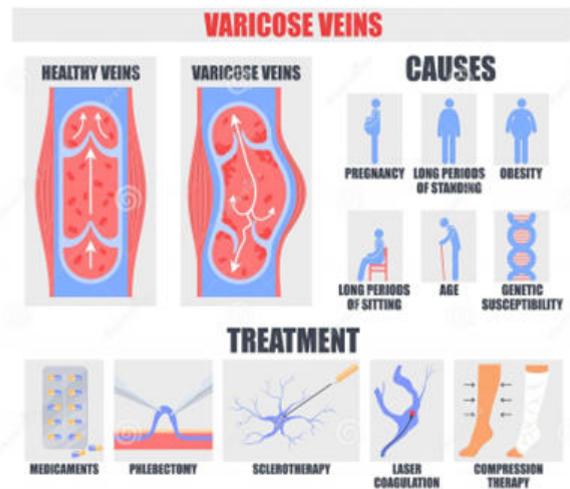
Rule out deep vein thrombosis (DVT) and map perforator involvement.

**CEAP Classification:**

Categorizes disease as Clinical (C0–C6), Etiologic (congenital, primary, secondary), Anatomic (superficial/deep), and Pathophysiologic (reflux/obstruction).

**3. Preoperative Preparation:**

- Counseling: Discuss procedural options, risks (e.g., nerve injury), and expected outcomes.
- Imaging Review: Confirm target veins (great/small saphenous, perforators) and plan approach.
- Informed Consent: Address anesthesia type, postoperative care, and rare complications (e.g.,



**Fig. 1.** Pictorial representation of the causes and treatment of varicose veins (source-dreamstime.com)

**Anatomy and Pathophysiology**

**1. Venous System:**

- Superficial veins (e.g., great/small saphenous veins) lie close to the skin, draining blood into deep veins (e.g., femoral, popliteal) via perforator veins.
- Valves in veins ensure unidirectional blood flow toward the heart, preventing retrograde flow.
- Dysfunctional perforators or valve failure disrupts this pathway, contributing to venous stasis.

thromboembolism).

**Indications And Contraindications**

Surgical intervention for varicose veins is indicated in patients experiencing severe, persistent symptoms such as pain, swelling, or cramping refractory to conservative therapies like compression stockings or lifestyle modifications. Additional indications include complications like venous ulcers resistant to healing, spontaneous bleeding from fragile superficial veins, or recurrent superficial thrombophlebitis causing localized inflammation and discomfort. Cosmetic concerns, particularly when linked to psychological distress or reduced quality of life, may also justify surgical evaluation. Conversely, contraindications include individuals deemed high-risk due to significant comorbidities (e.g., cardiopulmonary disease) that amplify perioperative hazards, as well as those with arterial insufficiency (e.g., peripheral artery disease), where compromised blood flow may impede healing. Surgery is avoided during pregnancy due to hemodynamic changes and potential vein resolution postpartum, and in cases of active deep vein thrombosis (DVT), where intervention could dislodge thrombi and precipitate embolism. Careful patient selection ensures optimal outcomes while minimizing avoidable risks. For several reasons, including cosmetic complaints and complications with thrombosis formation, varicose veins should be treated<sup>1</sup>.

**Surgical Techniques**

**1. Traditional Methods**

- **High Ligation and Stripping:** This procedure involves surgically tying off (ligating) the incompetent great saphenous vein (GSV) or small saphenous vein (SSV) at its junction with the deep venous system, followed by removal (stripping) of the affected vein segment. It remains effective for extensive superficial venous reflux.
- **Ambulatory Phlebectomy:** Small incisions are made along varicose tributaries, followed by extraction of veins using specialized hooks. Ideal for visible, tortuous veins not involving the saphenous trunks.

**2. Endovenous Thermal Ablation<sup>2</sup>**

- **Laser Ablation (EVLA):** A laser fiber is inserted into the target vein under ultrasound guidance, delivering thermal energy to induce collagen contraction and vein closure.
- **Radiofrequency Ablation (RFA):** Similar to EVLA, but uses radiofrequency waves to generate heat, achieving vein occlusion with a lower risk of post-procedural bruising.

**3. Non-Thermal Techniques<sup>3</sup>**

- **Mechanochemical Ablation (MOCA):** Combines mechanical endothelial disruption (via a rotating catheter) with simultaneous injection of a sclerosing agent to close veins without thermal damage.
- **Cyanoacrylate Closure (VenaSeal):** A medical adhesive is injected to bond vein walls, eliminating reflux. Avoids tumescent anesthesia and compression therapy post-procedure.

**4. Adjunctive Procedures**

- **Sclerotherapy:** Liquid or foam sclerosing agents are injected into smaller veins or telangiectasias, causing inflammation and fibrosis.
- **Perforator Vein Surgery:** Reserved for incompetent perforators contributing to recurrent ulcers, often addressed via subfascial endoscopic perforator surgery (SEPS).

**5. Considerations for Technique Selection**

- **Anatomy:** Vein diameter, tortuosity, and proximity to nerves influence choice (e.g., thermal ablation for straight GSV segments).
- **Patient Preference:** Minimally invasive options (e.g.,

VenaSeal) appeal to those seeking rapid recovery or avoiding compression garments.

- **Cost:** Traditional methods may be cost-effective in resource-limited settings, while newer technologies often incur higher upfront costs.

**Postoperative Care**

Effective postoperative management following varicose vein surgery begins with immediate compression therapy using graduated stockings or bandages to minimize swelling, reduce hematoma risk, and promote venous return. Patients are encouraged to ambulate early and engage in light exercises to enhance circulation while avoiding strenuous activities that could strain healing tissues. Pain management typically involves over-the-counter analgesics (e.g., acetaminophen) or short-term NSAIDs to address discomfort and inflammation, though opioids are rarely required. During follow-up, clinicians monitor for complications such as infection, deep vein thrombosis (DVT), or residual reflux, often utilizing duplex ultrasound to confirm successful vein closure and assess healing. Long-term use of compression garments (4–6 weeks or more) is advised to support recovery, prevent recurrence, and optimize cosmetic outcomes, with duration tailored to procedural complexity and individual healing progress. Regular evaluations ensure adherence to care protocols and address any late-onset issues, reinforcing patient compliance for sustained results. It will be several years before long term (≥ 10 years) data are known for the newer treatments. Studies need to include economic modelling which will help to guide the way services are delivered<sup>4</sup>.

**Complications**

While modern varicose vein procedures are generally safe, potential complications span intraoperative, postoperative, and long-term phases. Intraoperative risks include inadvertent nerve injury (e.g., saphenous or sural nerve damage during stripping or ablation), bleeding from perforator veins, and rare deep vein thrombosis (DVT) triggered by endothelial trauma. Postoperatively, localized infection may arise despite sterile protocols, while hematomas can develop if compression is inadequate. Skin-related issues like hyperpigmentation (from hemosiderin deposition) or telangiectasia (fine collateral veins) may emerge due to inflammatory responses. Long-term concerns focus on recurrence, often linked to incomplete ablation or new reflux pathways, and neovascularization—abnormal tiny veins forming near treated sites. Prevention and management hinge on technical precision (e.g., ultrasound-guided catheter placement to avoid nerves), judicious anticoagulation for high-risk patients, and meticulous wound care to reduce infection. Hematomas may require aspiration, while hyperpigmentation often resolves with time or topical therapies. Patient education on compression adherence and lifestyle modifications further mitigates recurrence risks.

**Outcomes and Comparative Effectiveness**

**1. Success Rates:**

- **Anatomical Closure:** Minimally invasive techniques (e.g., EVLA, RFA) achieve >90% closure rates at 1–2 years, comparable to traditional surgery.
- **Symptom Relief:** 80–95% of patients report reduced pain, swelling, and fatigue post-procedure, with faster improvement in thermal ablation vs. stripping.

**2. Recurrence Rates:**

- **Traditional Surgery:** 5-year recurrence rates of 20–30% due to neovascularization or missed tributaries.
- **Minimally Invasive Methods:** Lower recurrence (10–15% at 5 years) due to precise targeting and reduced tissue trauma.

**3. Patient Satisfaction:**

- **Cosmetic Results:** Non-thermal methods (e.g., VenaSeal,

foam sclerotherapy) yield minimal scarring, preferred for visible areas.

- Recovery Time: Endovenous techniques allow immediate return to light activities vs. 1–2 weeks with stripping.

#### 4. Cost-Effectiveness:

- Initial Costs: Thermal ablation and adhesive closure are more expensive than stripping but offset by reduced hospital stays.
- Long-Term Savings: Lower recurrence and complication rates with advanced techniques decrease repeat procedure costs.

### CONCLUSION

The surgical management of varicose veins has evolved significantly, shifting from invasive open procedures to minimally invasive, patient-centered techniques such as endovenous thermal ablation and adhesive closure. These advancements prioritize anatomical precision, reduced recovery time, and improved cosmetic outcomes while maintaining high success rates in symptom relief and venous closure. Despite the efficacy of modern methods, recurrence remains a challenge, underscoring the importance of thorough preoperative evaluation, individualized technique selection, and adherence to postoperative care protocols. Emerging technologies, including bioadhesives and advanced imaging, promise to further refine outcomes and expand treatment accessibility. However, cost-effectiveness and patient-specific factors—such as anatomy, comorbidities, and personal preferences—must guide clinical decision-making. As research continues to unravel the genetic and molecular underpinnings of venous disease, a holistic, multidisciplinary approach integrating surgery, lifestyle modification, and long-term surveillance will remain pivotal in optimizing patient quality of life and reducing the global burden of chronic venous insufficiency<sup>8</sup>.

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