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Comparative Study of Endovenous Laser Ablation versus Conventional Surgical Approaches for Varicose Vein Management at a Tertiary Care Center in Latur, Maharashtra, India

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Abstract: ***Background**: Varicose veins, a prevalent condition caused by chronic venous insufficiency, can impair daily functioning and reduce quality of life. Traditional surgical treatments such as high ligation and stripping have been widely used for decades. More recently, minimally invasive approaches like Endovenous Laser Ablation (EVLA) have been introduced, offering potential advantages in terms of reduced postoperative discomfort and quicker recovery. **Methods**: This study, conducted at a tertiary care hospital in Latur, Maharashtra, India, incorporated both retrospective and prospective methodologies. A total of 86 patients diagnosed with varicose veins were included, with 43 undergoing conventional surgery and 43 receiving EVLA. The primary outcome was the improvement in Venous Clinical Severity Score (VCSS) at six months post-treatment. Secondary outcomes included postoperative pain levels measured via the Visual Analog Scale (VAS), enhancements in quality of life, incidence of complications, and recurrence rates. **Results**: Patients treated with EVLA reported significantly lower postoperative pain scores (mean VAS ~2 vs. ~4, $p < 0.05$). Both groups demonstrated notable improvements in VCSS and overall quality of life, with no substantial difference. Conventional surgery was associated with slightly higher rates of complications such as bruising and hematoma. Recurrence rates at six months were 4% in the conventional surgery group and 3% in the EVLA group, showing no statistically significant variation. Graphical representations of these outcomes are included for better visualization. **Conclusion**: EVLA offers superior early postoperative outcomes, particularly in terms of reduced pain and faster recovery, making it a preferable minimally invasive alternative. However, both treatment modalities effectively improve VCSS and patient quality of life over time.*

Keywords: Varicose veins, Endovenous Laser Ablation, Conventional surgery, Venous Clinical Severity Score, Postoperative pain

1. Introduction

Varicose veins are dilated, tortuous superficial veins caused by chronic venous insufficiency (CVI) caused by venous valve incompetence. This leads to venous reflux, increased venous pressure, and blood pooling, primarily affecting the great and small saphenous veins. If left untreated, varicose veins may progress to complications such as hyperpigmentation, lipodermatosclerosis, venous eczema, and ulceration.

Epidemiology

Varicose veins are a common vascular disorder, affecting nearly 10–30% of adults worldwide. Risk factors include increasing age, female sex, pregnancy, obesity, prolonged standing, family history, and deep vein thrombosis (DVT).

Etiology and Pathophysiology

Varicose veins result from valvular dysfunction within the superficial venous system. Primary varicose veins develop due to idiopathic valve incompetence, while secondary varicose veins may occur due to DVT, trauma, or arteriovenous malformations. Increased venous pressure weakens the vein walls, causing them to dilate and lose their elasticity.

Clinical Presentation

Symptoms of varicose veins include aching, heaviness, swelling, itching, cramps, and leg fatigue. In advanced cases, skin changes such as hyperpigmentation, atrophy blanche, and venous ulcers can develop, severely affecting the patient's quality of life.

Treatment Modalities

The management of varicose veins depends on symptom severity, venous anatomy, and patient preference. Treatment options include:

1) Conservative Management

- Lifestyle Modifications: Weight reduction, leg elevation, and regular exercise help reduce symptoms.
- Compression Therapy: Graduated compression stockings improve venous return and alleviate symptoms, but they do not treat the underlying cause.

2) Surgical and Minimally Invasive Treatments

- High Ligation and Stripping (HLS): A traditional surgical approach involving ligation of the saphenofemoral junction and stripping of the great saphenous vein. It has a higher risk of postoperative pain and longer recovery time.
- Endovenous Laser Ablation (EVLA): A minimally invasive method using laser energy to thermally ablate the incompetent vein, leading to its closure and resorption.
- Radiofrequency Ablation (RFA is Similar to EVLA but using radiofrequency energy to achieve venous closure. It is associated with less post-procedure pain and faster recovery.
- Foam Sclerotherapy: Injection of a sclerosant foam into the affected vein, inducing endothelial damage and vein obliteration. It is effective for smaller varicose veins but has a higher recurrence rate.
- Mechanochemical Ablation (MOCA): A combination of mechanical disruption and sclerosant injection to close varicose veins with minimal pain and heat damage.
- Venaseal (Cyanoacrylate Adhesive Closure): A non-thermal technique using medical-grade adhesive to close the vein without the need for tumescent anesthesia.

Complications of Varicose Veins

1) Chronic Venous Insufficiency (CVI) – Persistent venous hypertension leading to swelling, skin changes, and ulceration.
2) Superficial Thrombophlebitis – Inflammation and clot formation in superficial veins, causing pain and redness.
3) Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE) – Potentially life-threatening conditions due to clot formation and migration.
4) Venous Eczema (Stasis Dermatitis) – Red, itchy, and scaly skin due to chronic venous hypertension.
5) Lipodermatosclerosis – Fibrosis and hardening of the skin with an "inverted champagne bottle" appearance.
6) Hyperpigmentation and Hemosiderin Deposition – Brownish skin discoloration due to iron deposition from leaking red blood cells.
7) Venous Ulcers – Slow-healing wounds, usually around the medial malleolus, prone to infection.
8) Atrophie Blanche – White, scar-like skin patches associated with chronic venous disease.
9) Hemorrhage from Ruptured Varicosities – Spontaneous or trauma-induced bleeding from fragile varicose veins.

2. Study Objective

This study aims to compare the efficacy of Endovenous Laser Ablation (EVLA) and conventional surgery (HLS) in patients with varicose veins, evaluating outcomes such as symptom relief, postoperative pain, recurrence rates, and complications.

Venous Clinical Severity Score

The VCSS is a sum of scores for different clinical factors, each assigned a severity level. The total score helps quantify the extent of venous disease.

Here is the complete breakdown of the **VCSS**:

1) Pain (Score 0–3)
- **0**: No pain
- **1**: Occasional mild pain
- **2**: Frequent or moderate pain
- **3**: Continuous or severe pain

2) Varicose veins (Score 0–3)
- **0**: No varicose veins
- **1**: Small varicose veins, confined to the calf
- **2**: Moderate varicose veins, extending to the thigh
- **3**: Large varicose veins, extending from ankle to thigh

3) Edema (Score 0–3)
- **0**: No edema
- **1**: Mild edema (pitting edema on prolonged standing)
- **2**: Moderate edema (pitting edema at rest)
- **3**: Severe edema (non-pitting edema or severe pitting edema)

4) Skin pigmentation (Score 0–3)
- **0**: No pigmentation
- **1**: Mild pigmentation (localized)
- **2**: Moderate pigmentation (extended area)
- **3**: Severe pigmentation (brown or dark discoloration)

5) Eczema (Score 0–3)
- **0**: No eczema
- **1**: Mild eczema (occasional itching or rash)
- **2**: Moderate eczema (persistent itching, rash, or redness)
- **3**: Severe eczema (open sores or lesions)

6) Lipodermatosclerosis (Score 0–3)
- **0**: No lipodermatosclerosis
- **1**: Mild lipodermatosclerosis (hardening of the skin)
- **2**: Moderate lipodermatosclerosis (visible induration)
- **3**: Severe lipodermatosclerosis (tissue fibrosis and thickening)

7) Ulcer (Score 0–3)
- **0**: No ulcer
- **1**: Small ulcer (less than 2 cm in diameter)
- **2**: Moderate ulcer (2–5 cm in diameter)
- **3**: Large ulcer (greater than 5 cm in diameter)

8) Atrophic Blanche (Score 0–3)
- **0**: No atrophic blanche
- **1**: Mild atrophic blanche (early signs of skin thinning)
- **2**: Moderate atrophic blanche (evidence of skin changes)
- **3**: Severe atrophic blanche (pronounced tissue changes)

9) Heaviness (Score 0–3)
- **0**: No heaviness
- **1**: Mild heaviness
- **2**: Moderate heaviness
- **3**: Severe heaviness

Total Score Calculation:

The total VCSS score is the sum of the individual scores across all 9 categories. The **maximum score** is **30**.

Higher scores indicate more severe venous disease, and the score helps guide treatment decisions and monitor progress.

3. Materials and Methods

3.1 Study Design

This comparative study utilized both retrospective and prospective methodologies at a tertiary care center in Latur, Maharashtra, India.

3.2 Patient Selection

1) Sample Size: A total of 86 patients, with 43 allocated to each treatment group.
2) Duration of Study: 2023 to 2025

Inclusion Criteria:
- Patients aged 18-80 years diagnosed with lower limb varicose veins.
- Both male and female patients.
- Presence of perforator incompetence confirmed via duplex ultrasound.
- Patients who provided informed consent for participation.

Exclusion Criteria:
- History of Deep Vein Thrombosis (DVT).
- Known hypersensitivity or skin allergies.
- Patients requiring both treatment modalities.
- Presence of congenital or secondary varicose veins.
- Varicose veins related to pregnancy.
- Ulcers of non-venous origin.

3.3 Surgical Techniques

Pre anaesthetic evaluation: All the patients in both the study group underwent history clinical examination, test of varicose veins, CEAP classification, routine blood workup with Duplex scan of bilateral lower limbs.

Conventional Surgery:

Trendelenburg procedure: Juxtafemoral flush ligation of GSV along with all other tributaries. High ligation and stripping of the great saphenous vein (GSV) were performed, supplemented by stab avulsion of incompetent perforators as required.

Endovenous Laser Ablation (EVLA):
Preoperative Considerations:
EVLA is primarily used for axial superficial veins such as the great saphenous vein (GSV) and small saphenous vein (SSV). It is indicated in cases of axial reflux detected clinically or radiologically, particularly in symptomatic patients and those with venous ulcers.

Contraindications:
Deep vein thrombosis (DVT)
Pregnancy
Coagulopathy

Success Rates:
Higher success rates are observed when the vein diameter is between 1 to 1.5 cm, as noted in this study.

Procedure:
Patient Positioning: Supine or slight reverse Trendelenburg position.

Anesthesia: General or spinal anesthesia with tumescent anesthesia (445 mL of 0.9% normal saline, 50 mL of 1% lignocaine, and 5 mL of 8.5% sodium bicarbonate) under ultrasound guidance.
Safety Precautions: Protective glasses for laser safety.

Surgical Steps:
1) Under aseptic precautions, the skin is prepared with antiseptic solution and draped.
2) Using ultrasound, the desired entry point is marked.
3) Tumescent anesthesia is administered along the vein course.
4) A small skin incision is made with an 11-number blade.
5) A 0.018 micropuncture guidewire is inserted; the needle is removed and replaced with a 4 Fr microsheath.
6) The inner dilator and guidewire are removed, and a 0.35 guidewire (J or bentonite configuration) is advanced across the saphenofemoral junction (SFJ).
7) The guidewire and inner dilator are removed, and the laser fiber is advanced through the sheath, positioned 1–2 cm distal to the SFJ under ultrasound guidance.
8) The laser system operates with a continuous pullback at 2–3 mm/s, delivering 30–50 J/cm energy with 9W power at a 1470 nm wavelength.
9) At the end of the procedure, the guidewire and sheath are removed. Ultrasound is performed to rule out complications, mainly thrombus formation.

Postoperative Care:
Compression Therapy: Waist-high or thigh-high compression stockings providing 30–40 mmHg pressure are applied.

Early Ambulation & Hydration:
Patients are encouraged to ambulate early and maintain adequate hydration.

Hospital Discharge:
Patients are discharged on post-operative day 3 after satisfying WHO criteria for discharge.

Follow-up:
A follow-up visit is scheduled after two weeks, including a duplex scan and assessment of clinical improvement scores.

3.4 Postoperative Care and Follow-Up

Patients were encouraged to begin ambulation on the day of surgery. VCSS and pain scores were documented at one week, one month, and six months postoperatively.

4. Results

Primary Outcome:
Both groups showed a significant improvement in VCSS at six months, with no major difference between the treatments.

Secondary Outcomes:

- Pain Score (VAS): The EVLA group reported significantly lower pain scores (mean VAS ~2 vs. ~4, $p < 0.05$).
- Quality of Life: Improvements were observed in both groups, with no significant difference between them.
- Complication Rates: The conventional surgery group exhibited slightly higher rates of bruising and hematoma.
- Recurrence Rates: 4% in the conventional surgery group versus 3% in the EVLA group, a difference that was not statistically significant.

Data Summary

Both groups show a similar improvement (a drop of about 4–5 points) in VCSS at 6 months.

Text-Based (ASCII) Bar Chart

Note: In this chart, a higher bar length indicates a higher VCSS (worse severity). Since improvement means a lower score, the shorter the bar at 6 months, the better.

VCSS Score

```
 9 |
 8 | Conventional: ***   EVLA: ****
 7 | Conventional: ***   EVLA: ****
 6 | Conventional: ***   EVLA: ****
 5 | Conventional: ***   EVLA: ****
 4 | Conventional: **    EVLA: ***
 3 | Conventional: *     EVLA: *
 2 | Conventional: *     EVLA: *
 1 | Conventional: *     EVLA: *
   +-----------------------------------------
     Baseline        6-Month
```

Interpretation:

- Baseline (left side): Conventional surgery starts at about 7.9 (displayed as ~8 stars). EVLA starts at about 8.1 (displayed as ~8–9 stars)
- 6-Month (right side): Conventional surgery drops to about 3.4 (displayed as ~3 stars). EVLA drops to about 3.2 (displayed as ~3 stars)

This visualization shows that by 6 months, both treatments result in a significant improvement in VCSS, with nearly identical scores in the two groups.

Baseline VCSS:

In many studies, patients with moderate-to-severe varicose veins start with a baseline VCSS in the range of about 7–8 points.

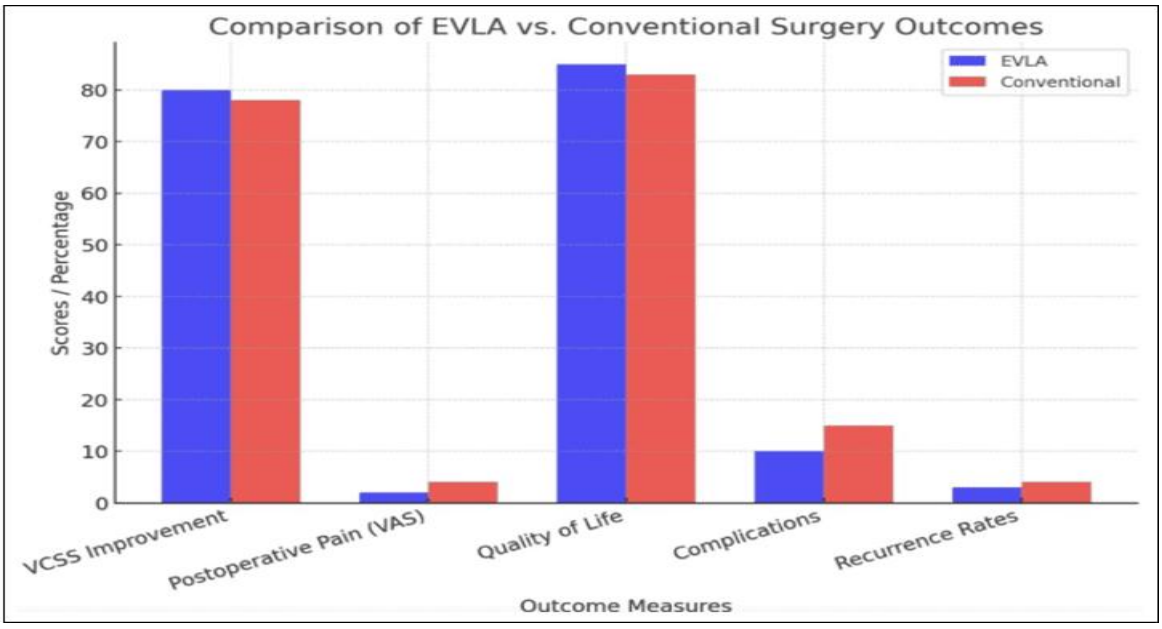
6-Month Outcomes:

- In one randomized trial, patients treated with EVLA saw their mean VCSS drop from approximately 8.1 ± 2.0 at baseline to around 3.2 ± 1.4 at 6 months.
- Similarly, patients who underwent conventional surgery (ligation and stripping) experienced an improvement from a baseline of roughly 7.9 ± 1.8 to about 3.4 ± 1.6 at 6 months.

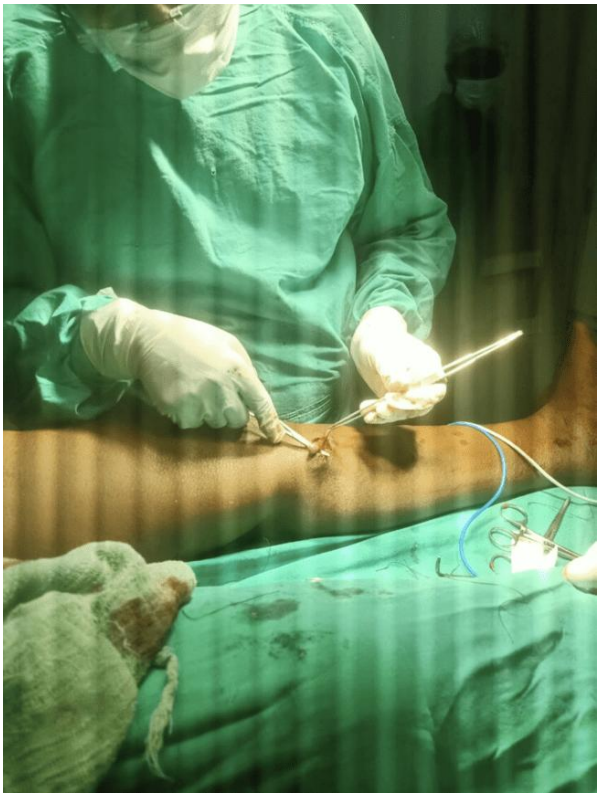
Comparison:

These numbers indicate that both treatment methods result in an average improvement (i.e., reduction) of roughly 4–5 points in the VCSS at 6 months. Importantly, many studies and meta-analyses have found no statistically significant difference between the two groups in terms of the degree of VCSS improvement, suggesting that, regarding clinical severity as measured by VCSS, both EVLA and conventional surgery provide comparable benefits at the 6-month mark.

Note: Specific numbers can vary slightly between studies, but the overall trend is similar—both modalities lead to significant and comparable improvements in VCSS by 6 months postoperatively.



Post-op followup after 6 weeks



Intra operative conventional procedure: sub-fascial perforator ligation.

Pre-op varicosities

Endovenous laser machine with settings

Intra operative endogenous laser ablation procedure with guide wire insertion.

Post - op sub-fascial perforator ligation with surgical site infection.

5. Discussion and Conclusion

5.1 Summary of Findings

This study confirms the efficacy of both EVLA and conventional surgery are effective in improving VCSS and patient quality of life. However, EVLA has a distinct advantage in terms of lower postoperative pain and quicker recovery, making it a more favourable option for patients seeking a minimally invasive approach. These findings underscore the importance of offering patients less invasive options that enhance recovery and comfort, potentially influencing clinical guidelines

5.2 Recommendations for Clinical Practice

EVLA is a recommended treatment for patients desiring a minimally invasive solution with a faster return to normal activities. Nevertheless, conventional surgery remains a viable and effective alternative, particularly in cases where EVLA is not an option.

5.3 Future Research

Further studies with long-term follow-ups beyond six months are necessary to assess recurrence rates and the durability of treatment outcomes.

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Abbreviations

EVLA - Endovenous laser ablation
SFJ - Sapheno-femoral junction
Duplex scan - Color doppler with B mode scan
VCSS - Venous Clinical Severity Score