Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 5s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Surgical Management of Varicose Veins by Endovenous Laser Ablation

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Cite this paper as: Varun Sisodia, Gagan Deep Kaur, Amit Singh, Abhishek Anand, Frankleena Parage, (2025) Surgical Management of Varicose Veins by Endovenous Laser Ablation. *Journal of Neonatal Surgery*, 14 (5s), 170-176.

ABSTRACT

Endovenous laser ablation (EVLA) is a very effective minimal invasive procedure to treat the patients of symptomatic lower limb varicosities with very low complication rate, low recurrence, early mobilisation and less duration of in-hospital stay.

Aims and objectives: To evaluates the outcomes of EVLA treatment in terms of symptom relief, cosmetic improvement, complication rates, recovery time, and long-term efficacy.

Materials and methods: This was single centre retrospective study conducted in 540 patients having diagnosis of symptomatic unilateral or bilateral lower limb varicose veins. All the patients were treated with EVLA procedure using a 900 nm diode laser under local anaesthesia with preoperative physical examination and duplex ultrasonography with vein mapping.

Results: In this study 540 patients underwent EVLA procedure, out of which bilateral EVLA was done in 210 patients and 330 patients underwent unilateral EVLA. Follow up of all the patients was done for 6 months and it was observed that 44 patients had induration, 37 patients had parasthesia, 21 patients had local haematoma,13 patients had recanalization, 8 patients had swelling at postoperative site and DVT occurred in 2 patients. Significant improvement was observed on pain visual analogue scale with 0 intensity by 3rd post operative week.

Conclusion: There is significant incidence of lower limb varicose veins and EVLA procedure serves to be effective in symptomatic relief, cosmetic improvement, lower complication rates, less recovery time, and good long-term efficacy.

Keywords: *varicose veins, Endovenous Laser Ablation (EVLA), effectiveness, symptom relief, cosmetic improvement, complication rates, recovery time, long-term efficacy*

1. INTRODUCTION

Varicose veins are caused by weak or damaged vein walls which causes the blood to pool or even lead to blood reflux. It affects a significant portion of the population, have long been a source of discomfort and aesthetic concerns (1). Endovenous laser ablation (EVLA) is a commonly used and very effective minimally invasive therapy to manage lower limb varicosities (2). Traditional treatment methods such as surgical stripping have been associated with higher complication rates and longer recovery times. Clinically, because EVLA took over surgical stripping as a result of its very high success rate with minimal complications at all laser wavelengths, laser powers, and pullback velocities used . There are two main modes of action in EVLA –

1. Heating of blood, vein wall, and peri-venous tissue by direct absorption of the laser power emitted from the fiber and scattered by the blood towards the other tissues, where the generated heat in the blood also diffuses to the vein wall [2-4].
2. Heating of the vein wall by heat transfer from the hot black layer of carbonized blood sticking to the fiber tip.(5,6)

2. METHODOLOGY

This retrospective study, conducted by Department of CVTS, UPUMS Saifai included 540 patients treated for varicose veins between January 2020 and December 2023. All the patients went through a thorough pre-procedure evaluation including a physical examination of varicose veins and duplex ultrasound was performed to map out the varicose veins and plan for the EVLA procedure.

Inclusion criteria : Symptomatic varicose veins with size of >4mm confirmed by duplex ultrasound and a CEAP (Clinical-Etiological-Anatomical-Pathophysiological) classification of C2 or higher.

The EVLA Procedure

All patients underwent EVLA using a 900 nm diode laser (Laser machine for EVLT, Starlas 250). Procedure was performed under local anaesthesia using (2% Lidocaine) and patient's comfort was ensured during the procedure. Following that Fiber Optic Probe was introduced into the great saphenous vein via 1cm a small skin incision at the knee. The laser was activated as the probe was gradually withdrawn from the vein. The heat generated by the laser caused the vein walls to collapse and seal shut. After the procedure, the incision site was covered with a small bandage, and patients are advised to wear compression stockings to support healing and improve circulation.

The duplex ultrasounds were performed in a standing position. Reflux was defined as a retrograde flow for more than 500 ms on provocation at the sapheno-femoral or sapheno- popliteal junction.

Data Collection:

Data were collected on patient demographics, procedure details, complications, and follow-up outcomes. Follow-up included clinical examination and duplex ultrasound at 1 week, 1 month, 6 months, and 1 year post-procedure. Patient satisfaction was assessed using a standardized questionnaire.

Data analysis: Data was entered and analysed by statistical package SPSS for Windows (SPSS (14), Chi cago, Illinois, USA). A p value of < 0.05 was significant. Data was presented as median, IQR and

Results:

The total number of patients operated by EVLA under the study was 540.Out of 540 patients, 210 were operated for both the limbs i.e. 420 limbs and 330 patients were operated for single limb i.e. 330 limbs. Total of 750 limbs were operated using EVLA. The mean age of the patients was 51 years ±9 years (range: 30 to 70 years). 301 (55.7%) were male patients and 239 (44.3%) were female (Table-1). Follow up of all the patients was done for 6 months. The most common complications were induration which was reported by 44 patients, followed by parasthesia which was observed in 37 patients and recanalisation in 13 patients. (Table-3, Figure-1) Pain Level was measured after surgery and each follow up using a VAS scale and same is represented with the help of Bar Diagram (Figure-2)

Follow up

All the patients were followed up till 6 months but maximum compliance rate was up to 6 weeks in which 100% of patients reported for regular weekly follow-up. The Parasthesia which was observed in 37 patients, it was relieved in 34 patients by 6 weeks of follow –up visit. Post operative Doppler is performed at 2 weeks and 6 weeks respectively after surgery. From the Doppler study at 2 weeks it was noticed that 13 patients out of 540 patients had developed recanalisation of Great Saphenous Vein (GSV). Among these 13 patients, 11 patients had not followed post operative advice on usage of gradual compression stockings. In these patients SFJ (Sapheno- femoral junction) Ligation with re EVLA of GSV if feasible was performed. In remaining 527 patients, atresia of GSV was observed without color flow signals. At 6 weeks doppler study also same findings were observed in these 527 patients. 42 patients out of 540 had active ulcer in limbs, healing was notices within 72 hours after surgery and ulcers were resolved within 10-15 days in all the 42 patients.

Table-1 (Socio-demographic profile of patients)

	Mean (SD)	Range
Age (years)	51±9	30-70
Gender	Number (n=540)	Percentage
Male	301	55.7

Female	239	44.3
Co morbidities		
Diabetes	78	14.4
Hypertension	94	17.4
H/O Smoking	116	21.9
Family History of Varicose veins	68	12.6
Compression Therapy	42	7.7

Table-2 (CEAP Clinical Classification)

C Class	**Number (n=540)**	**Percentage**
C2	280	51.9
C3	112	20.7
C4	68	12.6
C5	38	7.1
C6	42	7.7
Legs		
Left	167	30.9
Right	163	30.3
Both	210	38.8

Table- 3 Complications of EVLA (n=540)

Complications	Number	Percentage
Induration	44	8.2
Parasthesia	37	6.9
Local Haematoma	21	3.8
DVT	2	0.3
Recanalisation	13	2.4
Swelling	8	1.9

Table-4:

	Mean Duration	Standard Deviation
Surgical Time	30 Minutes	10
Hospital Stay	3 Days	2

Table-5 Improvement in mean VAS (Visual Analogue Scale) Score

	A f t e r Surgery	7 days	2weeks	3 weeks	4 weeks	5 weeks	6 weeks
Mean VAS Score	5	3	2	0	0	0	0

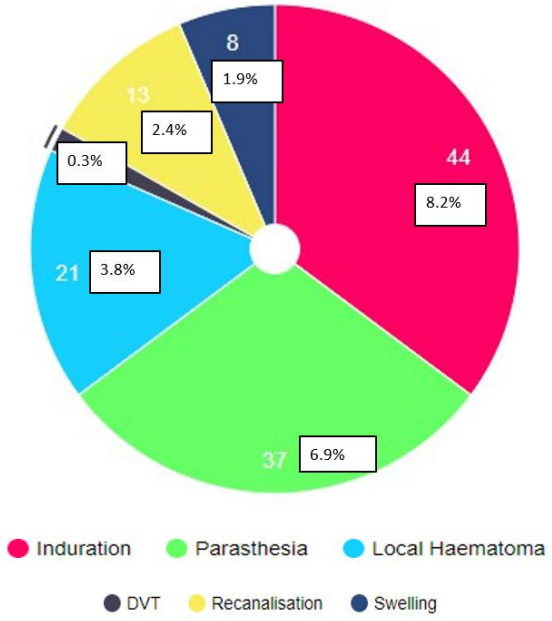

Figure-1 Complications of EVLA (n=540)

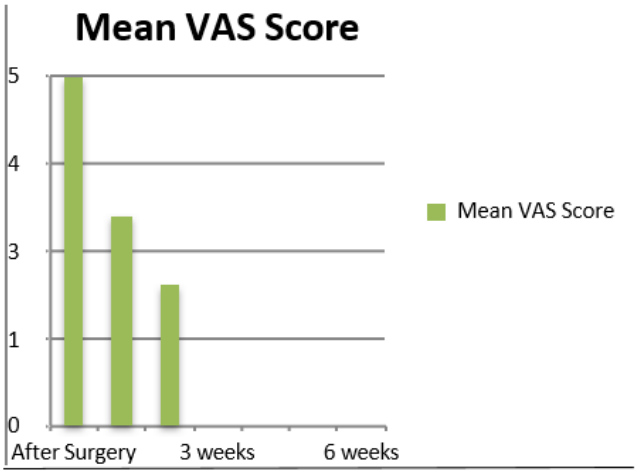

Figure-2

3. DISCUSSION

This study evaluated the outcomes of **Endovenous Laser Ablation (EVLA)** in the treatment of varicose veins, involving 540 patients. Our results confirm that EVLA is an effective and safe treatment option, with a low complication rate, rapid recovery, and significant improvement in symptoms such as pain and leg ulcers. These findings are consistent with previous studies demonstrating the benefits of EVLA in terms of efficacy, patient satisfaction, and low recurrence rates.

Patient Demographics and Clinical Characteristics

The mean age of patients in this study was **51 years** (±9), with a range from **30 to 70 years**. This age distribution is typical for varicose vein treatments, as varicose veins are more commonly diagnosed in middle-aged individuals, particularly in those over 40 years of age (1). The male-to-female ratio was **55.7% male** and **44.3% female**, a distribution consistent with other studies. While varicose veins are more prevalent in women, particularly due to hormonal changes and pregnancy, men also represent a significant proportion of patients, especially in the presence of risk factors such as family history and lifestyle factors (7).

The presence of comorbidities in our cohort, including **diabetes** (14.4%), **hypertension** (17.4%), and **smoking** (21.9%), is in line with prior research highlighting these as key risk factors for venous insufficiency and varicose veins (8 & 9). Management of these comorbidities is crucial for optimizing the surgical outcomes of EVLA and minimizing complications.

Clinical Classification (CEAP)

All the patients enrolled in the study underwent preoperative evaluation using duplex doppler (for vein mapping) and a CEAP (Clinical-Etiological-Anatomical-Pathophysiological) classification.

In terms of **CEAP classification**, most patients in our study were categorized as **C2** (varicose veins), with **51.9%** of patients in this group, followed by **C3** (edema) and **C4** (skin changes). This is consistent with other studies in which most patients seeking varicose vein treatment present in the early stages of disease, with varicose veins being the most common presenting symptom (10). The proportion of patients with more severe classifications (C5 and C6) was lower, which may reflect earlier intervention in this cohort or a trend toward treating varicose veins before progression to more severe complications such as venous ulcers (11).

Surgical Technique and Patient Management

The **mean surgical time** in this study was **30 minutes ± 10 minutes**, which is consistent with other reports on EVLA, where the procedure time typically ranges from 20 to 40 minutes depending on the extent of the vein treated (12 &13). The relatively short procedure time is one of the key advantages of EVLA over traditional surgical techniques, which are more invasive and require longer recovery periods. Furthermore, the **mean hospital stay** of **3 days** (±2 days) in this cohort is also in line with previous studies, which have demonstrated that EVLA, being minimally invasive, allows for shorter hospital stays and faster recovery times compared to open surgery (14).

Postoperative Complications

In terms of complications, the most common adverse event was **induration** (8.2%), which is a transient inflammatory response commonly seen after EVLA (15). **Parasthesia** was observed in **6.9%** of patients, which is slightly higher than the rates reported in some studies (around 3-5%) but is still considered a mild and transient side effect (12). The resolution of parasthesia in **34 out of 37 patients** by 6 weeks further emphasizes the generally favorable short-term outcomes for this complication. **Recanalisation** was observed in **2.4%** of patients, which is comparable to the recurrence rates reported in other EVLA studies (1-4%) (16). Notably, the majority of patients who experienced recanalisation had not adhered to post-operative instructions regarding the use of **compression stockings**, which are essential in preventing the reopening of treated veins. This finding underscores the importance of patient education and compliance in achieving optimal outcomes following EVLA. The incidence of **deep vein thrombosis (DVT)** was **0.3%** in this study, which is lower than the rates reported for traditional vein stripping surgery (1-2%) (12). EVLA is generally considered to have a lower risk of thromboembolic complications compared to more invasive surgical methods due to its minimally invasive nature.

Venous Ulcer Healing

One of the notable findings of our study was the rapid healing of **active ulcers** in **42 patients**, with complete resolution occurring within **10-15 days** after EVLA. This is consistent with other studies showing that EVLA not only improves venous symptoms but also promotes ulcer healing due to the restoration of normal venous blood flow (17). EVLA's ability to treat both varicose veins and associated complications, such as ulcers, is a significant advantage over traditional methods, where the healing of ulcers can be slower and less predictable.

Pain and Quality of Life

The **Visual Analogue Scale (VAS)** scores demonstrated a significant reduction in pain following EVLA, with a mean score of **5 immediately after surgery** dropping to **0** by **6 weeks post-surgery**. These findings align with previous studies that report rapid pain relief and high patient satisfaction following EVLA (17 &18). The ability to achieve near-complete pain

relief in such a short time frame is one of the most compelling advantages of EVLA, particularly when compared to traditional surgery, which can have longer recovery periods and more persistent post-operative discomfort.

Follow-Up and Patient Compliance

The high **follow-up compliance rate** (100% of patients attending regular weekly visits for the first 6 weeks) in this study is noteworthy. Post-operative follow-up is essential for detecting complications such as recanalisation or DVT early, and it provides an opportunity for additional interventions if necessary. While this level of compliance may not be typical in all settings, it reflects the importance of patient engagement in achieving optimal outcomes following EVLA (19).

4. LIMITATIONS

Despite the positive outcomes, this study has several limitations. The **follow-up period** was limited to 6 months, and longer-term follow-up would be useful to assess the durability of EVLA and the potential for recurrence beyond this time frame. Furthermore, the study was conducted at a single institution, which may limit the generalizability of the findings to other populations. Finally, although we report on complications, we did not explore in detail the factors influencing these outcomes, such as the specific techniques used or the role of patient factors (e.g., obesity, activity levels) in treatment success.

5. CONCLUSION

In conclusion, **Endovenous Laser Ablation (EVLA)** is a highly effective and minimally invasive treatment for varicose veins, offering low complication rates, rapid recovery, and significant improvements in symptoms. This study confirms the advantages of EVLA, particularly in terms of pain relief, ulcer healing, and low recurrence rates. However, patient compliance with post-operative care, particularly the use of compression stockings, is essential to optimize outcomes and minimize complications. Given its effectiveness and favorable risk profile, EVLA should continue to be considered a first-line treatment for varicose veins.

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