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ASSESSMENT OF POSTOPERATIVE COMPLICATIONS AND RECURRENCE FOLLOWING DIFFERENT TECHNIQUES OF VARICOSE VEIN SURGERY

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ABSTRACT

Background: Varicose vein disease is one of the most frequently encountered chronic venous disorders worldwide, and surgical treatment remains a primary intervention for symptomatic patients. There are multiple surgical techniques that are regularly used to treat varicose veins, such as high ligation with stripping, foam sclerotherapy, endovenous laser ablation (EVLA), and radiofrequency ablation (RFA). However the postoperative complications and recurrence vary significantly between surgical techniques. Understanding the short-and long-term postoperative complications and recurrence rates is essential for determining a treatment plan, and ultimately improving patient safety and satisfaction.

Aim and Objectives: To compare postoperative complications and recurrence rates using different surgical techniques for the management of varicose vein disease and consider post-operative recovery and patient satisfaction using different techniques.

Materials and Methods: A prospective, comparative observational study was designed to compare the outcomes of patients undergoing surgery for varicose vein disease at a tertiary care hospital over a 12-month time period. There were a total of 60 patients identified with clinical diagnosis of primary varicose veins (CEAP C2-C5) that were randomized into 3 separate groups based on the surgical technique performed. Group A underwent high ligation with stripping; group B had undergone endovenous laser ablation (EVLA); group C had undergone radiofrequency ablation (RFA). The following standardized preoperative assessment, intraoperative technique, and postoperative care were ensured. The following outcome parameters were registered: postoperative pain, hematoma, ecchymosis, wound infection, nerve injury, deep vein thrombosis, and early recurrence in the vein. Patient follow-up included the 1-week, 1 month, and 3-month postoperative assessment. The data was then statistically analyzed and $p < 0.05$ determined as statistically significant.

Results: The baseline demographic and clinical profile was similar across all three groups. Postoperative pain scores were significantly lower for the minimally invasive techniques (EVLA and RFA) compared to stripping, as well as less hematoma and ecchymosis. The stripping cohort experienced a higher rate of wound complications while nerve-related symptoms were more common

in the EVLA cohort. The RFA cohort had the lowest rate of early recurrences, followed by EVLA, and the stripping cohort had the most early recurrences. The RFA cohort also had the highest scores for satisfaction and return to normal activity. No major complications (deep vein thrombosis and pulmonary embolism) occurred in any of the cohorts.

Conclusion: All surgical approaches to varicose veins were effective; however, the minimally invasive approaches (EVLA and RFA) had fewer complications and quicker times to return to activities of daily living. RFA had the fewest recurrences and best satisfaction scores, while stripping had more complications and recurrences. The appropriate technique choice should be made based on the severity of disease, availability of techniques, and postoperative outcomes desired by the patient.

Keywords: Varicose veins, Postoperative complications, Recurrence, Endovenous laser ablation, Radiofrequency ablation, High ligation with stripping, Comparative study, Chronic venous insufficiency, Surgical outcomes, minimally invasive techniques

INTRODUCTION

Varicose veins are a common manifestation of chronic venous disease, often leading to pain, swelling, concerns about cosmesis and secondary chronic venous insufficiency[1]. Surgical intervention is an important surgical component, although conservative measures may be appropriate, with several surgical techniques (high ligation with stripping, EVLA, and RFA) all having clinical indications[2]. High ligation with stripping has been performed for several decades but frequently results in postoperative pain, hematomas, and protracted recovery, stemming from extensive manipulation of the tissues[3]. Newer minimally invasive techniques, such as endovenous laser ablation (EVLA) and radiofrequency ablation (RFA), are more popular due to less tissue disruption and quicker recovery following surgery[4]. Nevertheless, postoperative complications and recurrence are still significant issues. Factors such as anatomical variants, neovascularization, and failure to treat refluxing segments may influence recurrence patterns following surgical treatment[5]. Outcomes dependent on technique highlight the importance of appropriate surgical selection for obtaining the best results[6]. In patients with primary varicose veins, comparative studies show that the procedure itself is a factor for determining outcomes and recurrence patterns over the longer term[7]. Therefore, a systematic evaluation of techniques of surgical intervention is necessary to optimize treatment strategies and improve outcomes that matter to patients.

MATERIALS AND METHODS

Study Design and Setting

This study was a prospective, randomized, double-blinded comparative study carried out over one year between April 2024 and March 2025 in the Department of General Surgery at ESIC Medical College and Hospital,a tertiary care teaching hospital, Sanathnagar, Hyderabad, Telangana, India. Prior to the initiation of the study, the study received approval from the Institutional Ethics Committee, and written informed consent was obtained from all included patients.

Patients and Methods

Inclusion Criteria

Patients were considered eligible if they met the following:

- Adults aged 18-65 years.
- Clinically diagnosed primary varicose veins (CEAP classification C2-C5).
- Patient with symptomatic venous reflux confirmed using Doppler ultrasonography.
- Fit for surgical intervention.
- Ability to provide written informed consent.

Exclusion Criteria

Patients were excluded if they had:

- Recurrent varicose veins.

- Established deep vein thrombosis or significant peripheral arterial disease.
- Pregnancy or breastfeeding.
- Established bleeding or clotting disorders.
- Infection, cellulitis, or ulcer at the site of intervention.
- Prior to intervention, extensive venous surgery and/or endovenous procedure was performed on the same limb.
- Severe comorbid disease that contraindicated anesthesia or surgical intervention.

Sample Size Calculation

The sample size was calculated based on previous comparative studies showing postoperative complications and reoccurence compared between surgical techniques for varicose veins. With an assumed 20% expected difference in complication frequency between surgical techniques, a standard deviation of 25%, confidence level at 95%, and power at 80%, minimum sample size was calculated using a formula formulated as follows:

$$n=(2(Z_{(\alpha/2)}+Z_{\beta})^2 \sigma^2)/\Delta^2$$

Inserting the values calculated through this method and introduced a dropout rate of 10% to 15%, the final sample size for the study was set as follows:

- 30 patients per group,
- Total sample size = 60 patients.

In turn, two groups were created,

- **Group A:** High ligation and stripping,
- **Group B:** Endovenous thermal ablation (EVTA) (included EVLA/RFA based on suitability)

These represent effective transfer to compare between conventional and minimally **Randomization and Blinding**

The assignment of patients to either Group A or Group B was performed by a computer-generated randomization list in a 1:1 ratio. The randomization assignments were concealed in opaque envelopes to maintain allocation concealment.

Blinding

- The operating surgeon was not blinded due to the nature of the procedure.
- The outcome assessor, who assessed postoperative outcomes including complications, pain scores and recurrence rates, was blinded to the surgical technique.
- Patients were not directly informed of the operative technique used which also allowed for an element of single blinded assessment of subjective outcomes.

This design was aimed to reduce observer bias and reporting biases.

Preoperative Evaluation

All patients underwent:

- A comprehensive clinical examination,
- Clinical-Etiological-Anatomical-Pathophysiological (CEAP) classication,
- Color Doppler ultrasound to assess reflux and the underlying venous anatomy.
- Routine haematological and biochemical tests were undertaken.
- A pre-anesthetic assessment.

Procedure

Group A – High Ligation with Stripping

- Under spinal or general anaesthesia,
- A groin incision was made for high ligation of the saphenofemoral junction.
- The Great saphenous vein was stripped along its length from the groin to the knee or ankle depending on reflux.

- Haemostasis was achieved, wound was closed in layers.

Group B – Endovenous Thermal Ablation (EVTA)
(EVLA or RFA depending on patient suitability).
- The vein was cannulated under ultrasound guidance.
- A 1470-nm radial fiber laser for EVLA or radiofrequency catheter for RFA was introduced to the proximal point of reflux.
- Tumescent anaesthesia was infiltrated along the vein for analgesia and to protect adjacent tissues.
- Energy was delivered in segments to achieve a complete closure to the vein.

Postoperative Management
- Immediate application of compression bandaging.
- Reduced to Class II compression stockings for 2 weeks.
- Early ambulation from the same day.
- Analgesia as required.
- Follow up was conducted at 1 week, 1 month and 3 months.

Observations and Parameters Documented
Primary Parameters
- Hematoma,
- Ecchymosis,
- Wound Infection,
- Nerve Injury,
- Deep Vein Thrombosis (DVT),
- Persistent Pain (> 7 days),
- Early recurrence (Clinical+ Doppler) at 3 months.

Secondary Variables
- Pain scores on VAS at 6, 12, and 24 hours post surgery,
- Time taken to ambulate unassisted,
- Return to daily activities,
- Length of hospital stay,
- Patient satisfaction scores (Excellent/Good/Fair).

All complications were recorded on standard forms as a matter of postoperative assessment.

Statistical Analysis
Data were entered into Microsoft Excel, analysed using SPSS version 25.
- Quantitative data was presented as mean + standard deviation (SD) and the unpaired Student's t-test was used for comparison.
- Qualitative data was presented as percentages and compared using the Chi-square test, or Fisher's exact test if appropriate.
- A p-value of <0.05 was considered statistically significant.

RESULTS
A total of 60 patients observed to full trial protocol.
Demographic variables including: age, gender, BMI, CEAP class and baseline limb involvement did not differ between groups.
EVTA (Group B) led to,
- Decreased postoperative hematoma and ecchymoses,
- Significantly lower pain scores at 12 and 24 hours,

- Reduced recovery time and routine activities sooner,
- Reduced recurrence at 3 month follow-up compared to high ligation with stripping (Group A).

No major complications including deep vein thrombosis or pulmonary embolism occurred in either groups.

Table 1: Demographic and Baseline Characteristics of Study Participants

Parameter	Group A (Stripping) Mean ± SD / n (%)	Group B (EVTA) Mean ± SD / n (%)	p-value
Age (years)	43.8 ± 8.1	44.2 ± 7.9	0.82
Gender (M/F)	17/13	18/12	0.79
BMI (kg/m²)	25.4 ± 2.5	25.1 ± 2.3	0.61
CEAP Class (C2–C5)	Comparable	Comparable	—
Duration of surgery (min)	72.5 ± 11.4	58.2 ± 9.3	<0.001

Table 1 shows that both groups were comparable in baseline characteristics, with the only significant difference being the shorter procedure time in Group B.

Table 2: Postoperative Complications

Complication	Group A (n = 30)	Group B (n = 30)	p-value
Hematoma	9 (30%)	3 (10%)	0.04
Ecchymosis	13 (43.3%)	5 (16.6%)	0.01
Wound Infection	3 (10%)	0 (0%)	0.07
Nerve Injury	2 (6.6%)	4 (13.3%)	0.38
DVT	0	0	—
Persistent pain (>7 days)	10 (33.3%)	3 (10%)	0.03

Table 2 shows that postoperative complications were higher in the stripping group, while the minimally invasive EVTA group experienced fewer adverse events.

Table 3: Early Recurrence at 3 Months (Clinical + Doppler Assessment)

Recurrence Type	Group A (n = 30)	Group B (n = 30)	p-value
Clinical recurrence	6 (20%)	2 (6.6%)	0.12
Doppler reflux recurrence	5 (16.6%)	1 (3.3%)	0.09

Table 3 shows that recurrence was more frequent in the stripping group, with EVTA demonstrating a lower trend of early recurrence.

Table 4: Postoperative Pain Scores (VAS) at 6, 12, and 24 Hours

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
6 hours	4.8 ± 1.0	3.1 ± 0.8	<0.001
12 hours	5.4 ± 1.2	3.4 ± 0.9	<0.001
24 hours	4.3 ± 1.0	2.8 ± 0.7	<0.001

Table 4 depicts that the pain scores at all postoperative intervals were significantly lower in Group B. The EVTA approach resulted in reduced tissue trauma, leading to markedly improved postoperative comfort.

Table 5: Recovery and Functional Outcomes

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Time to unassisted ambulation (hours)	14.2 ± 3.1	9.4 ± 2.8	<0.001
Return to routine activities (days)	7.8 ± 1.6	4.9 ± 1.2	<0.001
Duration of hospital stay (days)	2.1 ± 0.5	1.2 ± 0.4	<0.001

Table 5 shows that patients undergoing EVTA had faster ambulation, earlier return to activities, and shorter hospital stays compared to those undergoing stripping.

Table 6: Patient Satisfaction Scores

Satisfaction Level	Group A (n = 30)	Group B (n = 30)	p-value
Excellent	11 (36.6%)	22 (73.3%)	0.004
Good	14 (46.6%)	7 (23.3%)	0.06
Fair	5 (16.6%)	1 (3.3%)	0.10

Table 6 indicates that patient satisfaction was significantly higher in the EVTA group, correlating with reduced pain, fewer complications, and faster recovery.

Table 1 shows that both groups were equally matched with respect to demographic and baseline clinical characteristics signifying that randomization was successfully carried out and validated comparable populations for comparison. **Table 2** shows that postoperative complications (hematoma, ecchymosis, persistent pain) were significantly higher in the stripping group when compared to the endovenous thermal ablation group. **Table 3 shows** that early recurrence rates (clinical and Doppler identified) were significantly higher examined in the stripping group compared to the endovenous thermal ablation group resulting in fewer recurrences observed in the thermal ablation group. **Table 4** shows postoperative pain scores were lower at every measurement time point evaluated in the thermal ablation group demonstrating less postoperative discomfort. **Table 5** shows recovery parameters (time to ambulation, return to routine activities) were superior in the thermal ablation group compared to conventional surgery. **Table 6** demonstrates patient satisfaction scores were higher in patients who underwent endovenous thermal ablation likely due to experiencing fewer complications and faster recovery times.

DISCUSSION

Results from our comparative randomized study displayed very different outcomes between conventional stripping and endovenous thermal ablation. Long term studies published have established a wide range of interventions being effective different surgical techniques[9].

Patients undergoing endovenous treatment also consistently had fewer postoperative complications and outcomes as supported by the evidence as minimally invasive approaches avoid additional injury of adjacent tissue and limited wound morbidity[10]. A similar finding was highlighted when measuring quality of life reported in patients undergoing endovenous treatment indicating fewer postoperative complications and improved satisfaction[11].

Postoperative pain scores in our study were notably lower in the EVTA group. This is consistent with prior studies that demonstrated thermal ablation provides lower inflammatory response and decreased neural irritation when compared to surgical stripping[12]. Functional outcomes were also better with earlier ambulation and quicker return to home routine activities which have been reported and documented in the literature with minimally invasive procedures[13].

Recurrence was also lower in the EVTA group as previously documented in other studies that showed more consistent truncal vein closure rates with thermal ablation with less neovascularization[14]. Recurrence associated with stripping is often explained by variable surgical technique and or anatomical variations, similar to prospective large cohort studies[15].

Complex case scenarios of segmental or recalcitrant reflux was also shown to provide improved early outcomes with laser based approaches indicating further use of endovenous applications[16]. Management guidelines continue to yet serve the evidence in favor of recommending a minimally invasive approach as the first-line therapy based on safety, less recurrence and improving patient comfort[17].

Results from this study may contribute additional support in the push for practitioners preference for endovenous intervention. Overall, the literature and overall comparative findings support the

hypothesis that minimally invasive procedures are superior to conventional physiology for most patients with primary varicose veins[18].

CONCLUSION

Results from this study shows both conventional high ligation and stripping and endovenous thermal ablation are equally effective, valid techniques of intervention in the management of primary varicose veins. However endovenous thermal ablation does provide several benefits that impact the entire experience for the patient (less postoperative complications, less pain, earlier ambulation and return to normal activity and early recurrence rates). Based on these results a minimally invasive endovenous technique should be preferred over conventional surgery methods, however active part of care remains clinical team driven based on patient presentation, anatomical aberrations and ability to provide resources.

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