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Original Research Article

USG -GUIDED COLD TUMESCENT ANAESTHESIA: ANALYSIS IN EVLT

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ABSTRACT

Background: Endovenous laser ablation (EVLA) is a standard treatment for saphenous vein incompetence, yet perioperative pain remains a significant concern. While tumescent local anaesthesia (TLA) is routinely used, it does not always guarantee complete analgesia. This study synthesizes evidence on a novel approach combining's - Guided cold saline tumescent solution (CSTS) local anaesthetics enhance patient comfort. **Materials and Methods:** In this prospective study, randomized controlled trials was performed. Patients underwent USG - Guided EVLA by 1470 nm laser machine with 600 nm fibre. Groups were compared based on tumescent solution temperature. First Cold: (+5°C to +7°C) vs. Second Control: (+27°C to +30°C). Primary outcomes were pain scores (VAS/NRS) and analgesic consumption. **Result:** Pooled analysis demonstrated that USG - Guided CSTS with local anaesthetics, resulted in significant reduction in intraoperative pain. Compared to control group, CSTS led to significantly lower pain scores immediately post-procedure (VAS: 2 vs. 5, $p<0.05$) and on subsequent days. Patients receiving CSTS consumed significantly fewer analgesics (mean: 1.7 vs. 3.4 tablets, $p<0.05$) and resumed daily activities faster (68% vs. 30.8% on POD1, $p<0.05$). Technical success was 100% in all groups. **Conclusion:** EVLA using USG - Guided CSTS with anaesthetics is a highly effective and safe technique that significantly improves perioperative comfort. This approach eliminates the risk of local anaesthetic toxicity and is particularly advantageous for bilateral or complex procedures.

INTRODUCTION

Endovenous laser ablation (EVLA) is a first-line, minimally invasive treatment for saphenous veins reflux and varicose veins. That provides high occlusion rates and faster recovery compared with conventional surgery. Despite advances in laser wavelength and fibre design, perioperative pain during EVLA remains a relevant clinical issue.

Cold saline tumescent anaesthesia has been proposed as an effective adjunct, as localized hypothermia reduces nerve conduction, induces vasoconstriction, and attenuates inflammatory response, potentially decreasing perioperative pain and ecchymosis and ultrasound-guidance provides support to optimal quantity infusion that prevents over dose of tumescent solution. While early studies suggest clinical benefit, comparative evidence remains limited. Furthermore, the use of large volumes of local anaesthetic and analgesics drugs, carry a risk of local anaesthetic, systemic toxicity, particularly in extensive or bilateral procedures.

This study evaluates the analgesic efficacy and safety of ultrasound-guided cold saline tumescent anaesthesia during EVLA of the GSV. We compare perioperative pain outcomes between cold and room-temperature tumescent solutions and assess

the feasibility of performing EVLA using cold saline tumescence without local anaesthetic drugs, supported by standardized intravenous sedation.

MATERIALS AND METHODS

Study Design and Population

This prospective randomized controlled trial was conducted in the Interventional Radiology unit of Department Radiodiagnosis, a tertiary care hospital. From January 2020 to May 2025. A total of 101 patients (mean age 47.2 ± 9.8 years; 52 males, 49 females) with primary lower-limb varicose veins and by duplex Doppler scan confirmed GSV reflux were enrolled. Exclusion criteria included previous venous surgery, deep venous thrombosis, arterial insufficiency, hypersensitivity to anaesthetic agents, pregnancy.

All participants provided written informed consent, and institutional ethics approval was obtained.

Randomization and Groups

Patients were randomly assigned into two groups:

- Group A: Control temperature tumescent anaesthesia (+27°C to +30°C). (CTTA)
- Group B: Cold saline tumescent solution anaesthesia (+5°C to +7°C). (CSTS)

Both tumescent solutions consisted of 500 ml of isotonic 0.9% saline, 10 ml of 2% lignocaine. In a subset of 49 limbs, cold saline tumescent solution (CSTS) was administered under.

Procedure

All procedures were performed under ultrasound guidance by the same interventional radiologist using a 1470 nm laser system (Meril Diode laser machine) with a 600 µm radial tip fibre. The laser fibre was introduced through a 6-Fr. sheath and positioned distal to the saphenofemoral junction. Tumescent infiltration (cold or room temperature) was achieved using a pump-assisted needle under ultrasound visualization. The Laser ablation procedure was standardized by delivering a target Linear Endovenous Energy Density (LEED) of approximately 60 J/cm, with a pullback rate of 2–3 mm/s.

Outcome Measures

The primary outcome was pain intensity assessed using the Visual Analog Scale (VAS) or Numeric Rating Scale (NRS) immediately post-procedure and on postoperative days (POD) 1, 2, and 3.

Secondary outcomes included:

- Analgesic consumption
- Time to resumption of daily activity
- Incidence of ecchymosis, induration, or paraesthesia
- Vein occlusion rate and diameter reduction
- Modified CEAP clinical score improvement
- Patient satisfaction (0–4 scale)

Statistical Analysis

Data were analysed using SPSS v26.0 (IBM Corp, Armonk, NY, USA). Continuous variables were expressed as mean ± SD, and categorical variables as percentages. Independent-sample t tests, χ^2 tests, and repeated-measures ANOVA were applied as appropriate. A p value < 0.05 was considered statistically significant.

RESULTS

Procedural Data

Mean LEED was 59.5 ± 3.2 J/cm in Group A and 60.4 ± 2.9 J/cm in Group B ($p > 0.05$). Mean tumescent volume was 462 mL vs 428 mL, respectively. All treated veins achieved immediate occlusion.

In the CSTS all procedures were completed without additional local anesthesia or intraoperative pain management. Patients were discharged within 2–3 hours.

Pain and Analgesic Use

Immediately after EVLA, mean VAS pain was significantly lower in the cold saline group (2.1 ± 0.8) than in the room-temperature group (4.3 ± 1.2; $p < 0.001$). On POD 1, 2, and 3, mean NRS scores were markedly lower in the cold group (1.0 ± 0.6, 0.8 ± 0.5, 0.3 ± 0.4) compared to room temperature (3.5 ± 1.1, 3.0 ± 0.9, 1.6 ± 0.6; $p < 0.05$ for all).

Patients in the cold group consumed fewer analgesic tablets (1.7 ± 0.8 vs 3.4 ± 1.2; $p < 0.05$) and resumed normal activity sooner (68% vs 31% by POD 1; $p < 0.05$).

Side Effects and Duplex Findings

Minor side effects (ecchymosis, induration, paraesthesia) were less common in the cold group (11%) than in the room-temperature group (34%; $p < 0.001$). No major complications such as infection, skin burn, or DVT occurred.

At 30 days, all treated veins remained occluded. The mean GSV diameter decreased from 1.0 cm to 0.7 cm in both groups. The modified CEAP score improved from 3.0 ± 0.7 to 1.1 ± 0.5 in the cold group and from 2.9 ± 0.6 to 0.7 ± 0.4 in the room-temperature group ($p > 0.05$).

DISCUSSION

This study demonstrates that cooling the tumescent solution significantly enhances patient comfort during EVLA without affecting procedural efficacy. Cold tumescence produced lower intraoperative pain, decreased postoperative analgesic needs, and fewer perivenous complications compared with room-temperature tumescence, consistent with previous findings. [7-10]

The analgesic mechanism likely involves peripheral vasoconstriction, slowing of nociceptive conduction, and reduced inflammatory mediator release.[11] The resultant “thermal buffer” minimizes tissue damage and pain transmission.

Our results align with those of Eroglu and Yasim,[7] who observed less pain and ecchymosis after EVLA using cooled tumescent anaesthesia. Similarly,

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studies on cooled solutions in liposuction and dermatologic laser procedures report improved patient comfort and reduced bruising. [12,13]

The cold saline tumescent solution under sedation subgroup further demonstrates the feasibility of performing EVLA without local anaesthetic infiltration. Intravenous sedation combined with cold perivenous infiltration achieved full analgesia and early discharge, supporting its potential as a day-care, anaesthetic-free approach.

No significant difference in occlusion rate or CEAP score improvement was noted between groups, confirming that the temperature modification does not compromise technical success.

Limitations

This study's limitations include a single-centre design, relatively short follow-up, and absence of blinding. Longer-term studies with larger sample sizes are warranted to confirm durability and recurrence outcomes. However, the consistent direction and statistical significance of the results across all investigations strengthen the validity of the conclusions. We recommend this approach as a valuable advancement in office-based venous practice, particularly for complex cases requiring maximal patient comfort and safety.

CONCLUSION

Cold tumescent anaesthesia provides superior intra- and postoperative comfort, reduces pain and side effects, and enables rapid recovery without compromising efficacy.

The cold saline tumescent technique under sedation may represent an effective, anaesthetic-free, day-care option for EVLA in appropriately selected patients.

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