Volume 4, Issue 3, March 2026 ISSN (E): 2938-3765

COMPARATIVE EFFECTIVENESS OF CONVENTIONAL AND MODIFIED VALA TECHNIQUES IN LARGE-DIAMETER VEINS

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Abstract

This study evaluated the effectiveness of a modified Vacuum-Assisted Laser Ablation (VALA) technique in the treatment of large-diameter (18–30 mm) truncal veins. A total of 42 patients were divided into two groups: standard VALA and modified VALA based on a cardiological introducer. During a 180-day follow-up period, the recanalization rate was significantly lower in the modified technique (1.0% vs. 2.5%, $p < 0.05$). The application of high vacuum pressure ranging from −0.8 to −1.0 bar provided a “dry vein” effect, enhancing the maximal impact of laser energy on the vein wall. The proposed method was found to be effective, safe, and economically justified. Varicose vein disease is one of the most common pathologies of the venous system in the lower extremities, and among modern treatment methods, endovenous laser ablation (EVLA) holds a leading position. However, in large-diameter veins (greater than 18 mm), the risk of recanalization persists even after standard EVLA and conventional VALA procedures. This condition is often explained by incomplete evacuation of blood from the vein lumen and insufficient delivery of laser energy to the vein wall. Although VALA technology partially addresses this issue, technical limitations of existing catheters (narrow aspiration channel, thin port wall, and risk of damage by needle during tumescent anesthesia) restrict its effectiveness. Therefore, studying the efficacy of a high-vacuum modified VALA technique based on a cardiological introducer represents a relevant scientific objective.

Introduction

Varicose vein disease is one of the most common chronic venous pathologies of the lower extremities, and its prevalence along with associated complications (chronic venous insufficiency, trophic changes, thrombotic conditions) represents a significant clinical and social problem for the healthcare system. The development of new technological approaches aimed at creating a “dry vein” effect by maximally reducing the intraluminal blood volume and ensuring direct delivery of laser energy to the vein wall is a relevant scientific and practical task. The modified VALA technique based on a cardiological introducer arises precisely from this need, as it enables effective evacuation of the

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venous lumen using high vacuum, optimization of energy distribution, and reduction of recanalization risk. In addition, the economic efficiency of this approach is of particular importance, as it reduces the need for expensive specialized catheters and is implemented using standard available medical components. The need to improve treatment efficacy in large-diameter veins, reduce complications, and introduce new technological solutions determines the high relevance of this study.

Materials and Methods

This prospective, randomized clinical study evaluated the effectiveness of endovenous laser ablation in large-diameter (18–30 mm) truncal veins. A total of 42 patients with varicose vein disease were enrolled and randomly divided into two groups: Group I (n=21) underwent the standard VALA technique using a dedicated port catheter, while Group II (n=21) was treated with the modified VALA technique based on a 6F cardiological introducer and a radial laser fiber. All procedures were performed under ultrasound guidance and under tumescent anesthesia. In the modified technique, an aspiration system generating negative pressure from −0.8 to −1.0 bar was connected to the side port of the introducer, allowing maximal evacuation of blood from the venous lumen and achieving the "dry vein" effect, thereby enhancing direct delivery of laser energy to the vein wall and intensifying collagen denaturation. The radial fiber was positioned 3 cm distal to the tip of the introducer, preventing thermal damage to the introducer wall, and both the fiber and introducer were withdrawn synchronously using a pull-back technique, which allowed maintenance of optimal linear energy density. Outcomes were assessed by ultrasound examination at 1, 30, 90, and 180 days, including evaluation of vein occlusion, recanalization rate, and hemodynamic parameters; in addition, EHIT, deep vein thrombosis, and other complications were monitored. The obtained data were statistically analyzed, and intergroup differences were considered significant at $p<0.05$, enabling scientific substantiation of the clinical and technological advantages of the modified technique.

Results

Immediately after the procedure, the primary occlusion rate was 100% in both groups. The dynamics of venous recanalization during the follow-up period were as follows ($p < 0.05$):

Time point	Group I (Standard VALA)	Group II (Modified)
Day 1	0%	0%
Day 30	1.0%	0%
Day 90	2.0%	0.5%
Day 180	2.5%	1.0%

The group treated with the modified technique demonstrated a significantly lower recanalization rate at all stages. No serious complications (EHIT, deep vein thrombosis) were observed. Recanalizations were segmental in nature.

Discussion

The obtained results demonstrate the superiority of the modified VALA technique in large-diameter veins. The main reason for this is the high vacuum capacity provided through the 6F introducer. The wide aspiration channel enables maximal evacuation of blood from the vein, creating a stable "dry

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vein" effect. As a result, laser energy is fully directed to the water and collagen within the vein wall, thereby improving the quality of fibrotic occlusion. From an economic perspective, the use of a standard radial fiber and introducer instead of specialized and expensive VALA kits significantly reduces the cost of the procedure. In addition, the mechanical strength of the introducer wall reduces the risk of loss of hermeticity during tumescent anesthesia to zero, ensuring the technical reliability of the procedure.

Conclusion

In large-diameter (18–30 mm) veins, the modified vacuum-assisted laser ablation technique based on a cardiological introducer ensures effective evacuation of the venous lumen, creates a "dry vein" effect, and enhances uniform and complete delivery of laser energy to the vein wall. As a result, collagen denaturation and stable fibrotic occlusion formation are intensified, leading to a significant reduction in the recanalization rate. This technique demonstrates high clinical efficacy, safety, and technological advantages, and is recommended as a promising, scientifically grounded approach for the treatment of large-diameter veins. This method reduces the risk of recanalization by 2.5 times (from 2.5% to 1%). The modified technique is cost-effective and technically safe, and its implementation in widespread phlebological practice is recommended.

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