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Sclerotherapy treatment in lower extremity veins: Early results from a single center

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Abstract

This retrospective observational study aimed to evaluate the complication rates and predictors of post-procedural complications following liquid polidocanol sclerotherapy in patients with superficial venous disorders. Demographic characteristics, treatment-related variables, and post-procedural adverse events were analyzed in 153 patients who underwent a total of 779 sclerotherapy sessions. Any complication occurred in 55 patients (35.9%), corresponding to a per-session complication rate of 7.1%. The most frequently observed adverse events were erythema, ecchymosis, and localized pain, all of which were self-limiting and clinically manageable. No cases of deep vein thrombosis, anaphylactic reaction, or neurological complications were identified. Multivariable logistic regression analysis demonstrated that the number of treatment sessions was the only independent predictor of complication development. Overall, liquid polidocanol sclerotherapy exhibited a favorable safety profile, with only minor transient complications and no major systemic adverse events, while an increasing number of treatment sessions was associated with a higher risk of post-procedural complications.

Keywords: Sclerotherapy, polidocanol, venous insufficiency, complications, varicose veins

Introduction

Sclerotherapy is a widely used minimally invasive treatment modality for superficial venous disorders, particularly telangiectasias, reticular veins, and small varicose veins, and represents a cornerstone of modern phlebology practice for both clinical and cosmetic indications [1–4]. In recent years, its use has expanded to the management of venous malformations and selected vascular anomalies [5,6]. The technique is based on intraluminal injection of a sclerosant agent, most commonly polidocanol, resulting in endothelial damage, thrombosis, fibrosis, and eventual obliteration of the target vein [2,7,8]. Due to its low cost, outpatient feasibility, ease of application, and favorable patient comfort, sclerotherapy is widely preferred in routine clinical practice and is frequently used alongside surgical, endovenous, radiofrequency, and laser techniques [9–11].

Although sclerotherapy has a favorable safety profile, various local and, rarely, systemic complications may occur following treatment. Most reported complications are minor and self-limiting, including ecchymosis, erythema, matting, and hyperpigmentation; however, more serious adverse events such as skin necrosis and thrombophlebitis have also been described [2,12–14]. Complication development may be influenced by several patient- and procedure-related factors, including sclerosant concentration, injection technique, vessel diameter, and underlying venous pathology. However, the relationship between cumulative treatment burden, reflected by the number of treatment sessions, and complication risk remains insufficiently investigated. Furthermore, the predictive role of duplex ultrasound-detected venous insufficiency in post-procedural complications remains unclear [2,12].

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Therefore, this study aimed to identify predictors of complications following liquid polidocanol sclerotherapy in a real-world clinical cohort. In particular, the predictive roles of patient age, skin type, ultrasound-detected venous insufficiency, prior surgical history, and the number of treatment sessions were evaluated in relation to post-procedural complication development.

Material and Methods

Ethics Approval and Informed Consent

This study was approved by the Non-Interventional Scientific Research Ethics Committee of Gülhane Training and Research Hospital, University of Health Sciences, with decision number 2025/38 dated 06.02.2025. In order to increase the sample size, an amendment was submitted to extend the patient inclusion period, which was approved by the ethics committee and the study was accordingly updated on 02.04.2026.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent revisions. Due to the retrospective design of the study and the use of anonymized patient data, the requirement for written informed consent was waived by the ethics committee.

Study Design and Population

This retrospective observational study included patients who underwent liquid polidocanol sclerotherapy for superficial venous disorders between September 2023 and February 2026. Inclusion criteria were age between 18 and 65 years, presence of telangiectasia, reticular veins, or small-caliber varicose veins suitable for liquid sclerotherapy, and availability of complete clinical and follow-up data. Patients who were pregnant or breastfeeding, had a history of deep vein thrombosis, thrombophlebitis, or pulmonary embolism, had known hypersensitivity to polidocanol, or had incomplete records were excluded. All eligible patients treated during the study period were included in the analysis.

Demographic and clinical data were retrospectively obtained from institutional records and included age, number of treatment sessions, ultrasound-detected venous insufficiency, prior surgical history, and skin type according to the Fitzpatrick classification. Post-procedural complications were recorded and patients were routinely followed. Following the procedure, patients were routinely evaluated at 7–10 days, 1 month, and 3 months to assess treatment response and to identify and document any procedure-related complications.

Intervention Technique

Patients with significant truncal venous insufficiency underwent adjunctive venous interventions, including endovenous laser ablation (EVLA) of the great saphenous vein (GSV) and/or small saphenous vein (SSV), with or without phlebectomy, prior to sclerotherapy. Following these interventions, residual superficial telangiectatic or reticular veins were treated with liquid polidocanol sclerotherapy. In patients who underwent adjunctive venous interventions, including EVLA, sclerotherapy of the remaining telangiectatic or reticular veins was initiated after completion of the recommended 6-week postoperative compression therapy period. Patients without clinically significant venous insufficiency or those with mild reflux not requiring surgical intervention underwent sclerotherapy alone.

Sclerotherapy was performed under appropriate aseptic conditions. Polidocanol injections were administered using 1 mL syringes, with the volume and technique tailored according to the target vessel diameter and anatomical location. Each ampoule of polidocanol was divided into 3–4 separate syringes, each containing 0.5–0.7 mL, and used in liquid form. Injections were performed intraluminally using fine-caliber needles, including 29G (0.33 mm × 12.7 mm), 30G (0.30 mm × 8 mm), and 31G (0.25 mm × 6 mm). For superficial and small-caliber vessels, 30G and 31G needles were preferred.

To ensure procedural standardization, polidocanol concentration was selected based on vessel diameter: 0.5% was used for telangiectasias and small reticular veins, whereas 1% was preferred for relatively larger reticular or small varicose veins. The sclerosant agent was administered directly into the target vessel lumen using a low-pressure, slow injection technique, and intravascular placement was confirmed by aspiration prior to injection.

In accordance with national guideline recommendations, the total dose of polidocanol was limited to a maximum of 2 mg/kg per session. Accordingly, for a 70 kg patient, the maximum allowable dose was considered to be 140 mg, and all procedures were performed within these safety limits. The total amount of polidocanol used per session was planned independently of concentration and kept within the recommended maximum dose range, with routine practice generally limited to a maximum of two ampoules per session.

Injection volume was adjusted according to vessel diameter, with higher volumes applied when necessary in larger vessels. Injection was immediately discontinued in cases of blanching suggestive of extravasation or in the presence of unexpected severe pain. Sclerotherapy sessions were generally performed at intervals of 4–7 days, depending on clinical response and patient availability.

Compression therapy was applied in all patients following the procedure. Compression stockings or elastic bandages were initiated immediately after treatment, and patients were instructed to wear compression stockings providing 23–32 mmHg pressure for three weeks to enhance treatment efficacy and minimize the risk of hyperpigmentation. In addition, routine post-procedural topical anti-inflammatory and venoactive treatments were prescribed according to institutional practice, and patients were advised to avoid sun exposure for at least two weeks.

Definition and Management of Complications

Immediately after each procedure, a low-dose topical corticosteroid together with topical preparations containing aescin, diethylamine salicylate, and mucopolysaccharide

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polysulfate was routinely applied as part of standard post-procedural care.

Complications documented during routine follow-up were retrospectively extracted from the institutional medical records and classified according to established criteria used in the sclerotherapy literature. Ecchymosis was defined as localized bruising at the injection site, erythema as transient redness and warmth along the treated vein, and injection-site pain as discomfort persisting beyond the immediate post-procedural period without evidence of infection or thrombophlebitis. These local reactions were managed conservatively with topical anti-inflammatory and venoactive agents when required.

Telangiectatic matting was defined as the appearance of fine reddish-purple vessels within or around the treated area after sclerotherapy. Patients with matting underwent duplex ultrasonography to assess great and small saphenous vein reflux and were followed clinically, with adjunctive laser treatment considered when appropriate. Pruritus was defined as localized itching without other signs of hypersensitivity.

Hyperpigmentation was classified as transient if it resolved within three months and as persistent if it remained thereafter. Patients with hyperpigmentation were treated with a topical hydroquinone-containing depigmenting agent. Skin necrosis was categorized according to lesion size (< 2 mm or 2–5 mm) and managed with local wound care, topical antibiotic ointment, dressings, and oral antibiotics when indicated, followed by topical scar-reducing therapy during healing. The single patient who developed thrombophlebitis received low-molecular-weight heparin, a nonsteroidal anti-inflammatory drug, and topical treatment for 10 days.

Although no major systemic adverse events occurred in this cohort, standard definitions were prespecified. Deep vein thrombosis was defined as duplex ultrasound-confirmed thrombosis of the deep venous system. Anaphylaxis was defined as an acute systemic hypersensitivity reaction. Stroke and transient ischemic attack were defined according to standard neurological criteria, with transient ischemic attack resolving within 24 hours. Visual disturbance, chest tightness, and dry cough were considered transient symptoms occurring shortly after treatment in the absence of another ophthalmologic or cardiopulmonary cause.

Sclerotherapy was discontinued in patients who developed skin necrosis or thrombophlebitis. In patients with all other procedure-related complications, treatment was continued after appropriate clinical management.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 22.0. Continuous variables were presented as mean ± standard deviation or median according to distribution characteristics, while categorical variables were expressed as frequencies and percentages. Group comparisons were performed using the independent-samples t-test or Mann–Whitney U test for continuous variables and the chi-square or Fisher's exact test for categorical variables, as appropriate. The primary outcome was defined as the presence of any complication. Exploratory binary logistic regression analysis was performed to identify independent predictors of complication development. Due to the limited number of events for several complications, regression analyses for individual complications were not performed. A p-value < 0.05 was considered statistically significant.

Results

A total of 153 patients who underwent liquid polidocanol sclerotherapy for superficial venous disorders were included in the study. The mean age of the cohort was 41.35 ± 8.05 years. The mean number of treatment sessions was 5.09 ± 3.22, with a median of 5 sessions and a range of 1–26 sessions. Ultrasound-detected venous insufficiency was present in 18 patients (11.8%).

The number of sclerotherapy sessions showed a relatively wide distribution within the study cohort (Table 1). The mean number of sessions was 5.09 ± 3.22, with a median of 5 sessions and a range of 1–26 sessions. Most patients underwent between 3 and 6 treatment sessions. The most common treatment frequencies were 6 sessions in 31 patients (20.3%), 5 sessions in 28 patients (18.3%), 4 sessions in 22 patients (14.4%), and 3 sessions in 21 patients (13.7%). Lower session counts were also common, whereas higher cumulative session numbers were observed only in a small subset of patients, indicating considerable variability in cumulative treatment burden among individuals. Representative clinical images demonstrating pre- and post-treatment appearance following liquid polidocanol sclerotherapy are shown in Figure 1.

Overall, at least one complication was observed in 55 patients (35.9%). All observed complications were self-limiting and clinically manageable. The most common complications were erythema, observed in 31 patients (20.3%), ecchymosis in 25 patients (16.3%), and localized pain in 16 patients (10.5%). Less frequent complications included matting in 5 patients (3.3%), pruritus in 4 patients (2.6%), and transient hyperpigmentation in 3 patients (2.0%) and persistent hyperpigmentation in 1 patient (0.7%).

Small skin necrosis was observed in 3 patients (2.0%), including 2 lesions smaller than 2 mm and 1 lesion measuring 2–5 mm, whereas thrombophlebitis developed in 1 patient (0.7%). The timing of complication onset varied among patients, and no consistent relationship was observed between complication development and a particular treatment session. The only notable exception was skin necrosis, which occurred after the first sclerotherapy session in one patient with Fitzpatrick skin type II. Patient-based and session-based complication rates, calculated from a total of 779 sclerotherapy sessions, are summarized in Table 1. Representative clinical examples of post-procedural complications are presented in Figure 2.

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No cases of deep vein thrombosis, anaphylactic reaction, severe tissue necrosis, stroke, transient ischemic attack, visual disturbance, chest tightness, or dry cough were observed during the study period (Table 1).

As shown in Table 2, patients who developed complications underwent a significantly higher number of sclerotherapy sessions compared with those without complications ($p = 0.011$). In contrast, age, ultrasound-detected venous insufficiency, prior surgical history, and Fitzpatrick skin type distribution did not differ significantly between the groups (all $p > 0.05$).

As shown in Table 3, no significant association was observed between ultrasound-detected venous insufficiency and the development of individual post-procedural complications or the composite outcome of any complication (all $p > 0.05$). Although ecchymosis was numerically more frequent in patients with venous insufficiency (22.2% vs. 15.7%), this difference did not reach statistical significance ($p = 0.500$). Similarly, the rates of erythema, localized pain, matting, thrombophlebitis, pruritus, persistent hyperpigmentation, and skin necrosis were comparable between patients with and without ultrasound-detected venous insufficiency. No anaphylactic reactions were observed in either group.

Binary logistic regression analysis was performed to identify independent predictors of post-procedural complications (Table 4). The overall model was statistically significant (Omnibus test, $p = 0.020$) and demonstrated acceptable goodness-of-fit according to the Hosmer–Lemeshow test ($p = 0.157$). The model explained approximately 10.1% of the variance in complication development (Nagelkerke $R^2 = 0.101$).

Among the evaluated variables, only the number of sclerotherapy sessions was identified as an independent predictor of complication development (OR = 1.221, 95% CI: 1.070–1.393, $p = 0.003$). Specifically, each additional treatment session was associated with an approximately 22% increase in the likelihood of developing any complication. In contrast, age, ultrasound-detected venous insufficiency, and prior surgical history were not significantly associated with complication risk (all $p > 0.05$).

Variables demonstrating clinically meaningful associations or relevance in univariate analyses were considered for inclusion in the multivariable model.

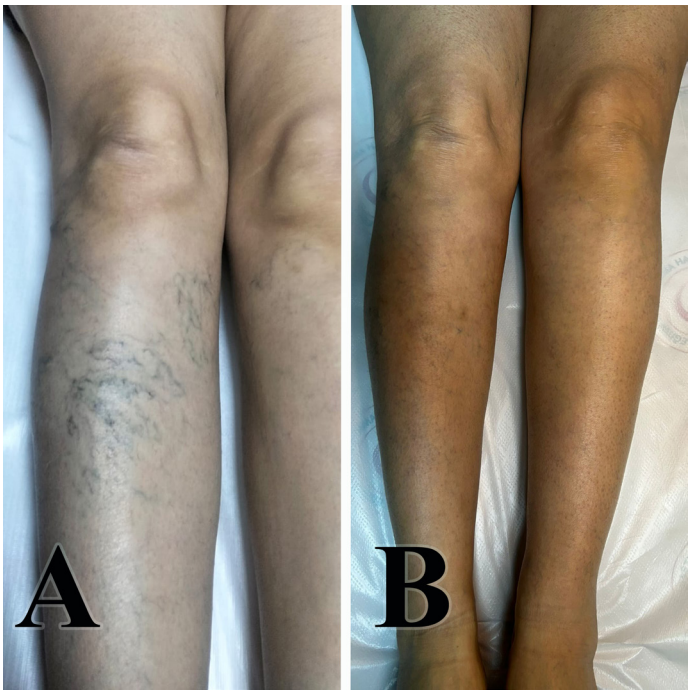

Figure 1. Representative clinical photographs of a patient undergoing liquid polidocanol sclerotherapy for superficial lower extremity venous lesions. (A) Pre-treatment appearance of superficial venous lesions before sclerotherapy. (B) Post-treatment appearance demonstrating cosmetic improvement following sclerotherapy

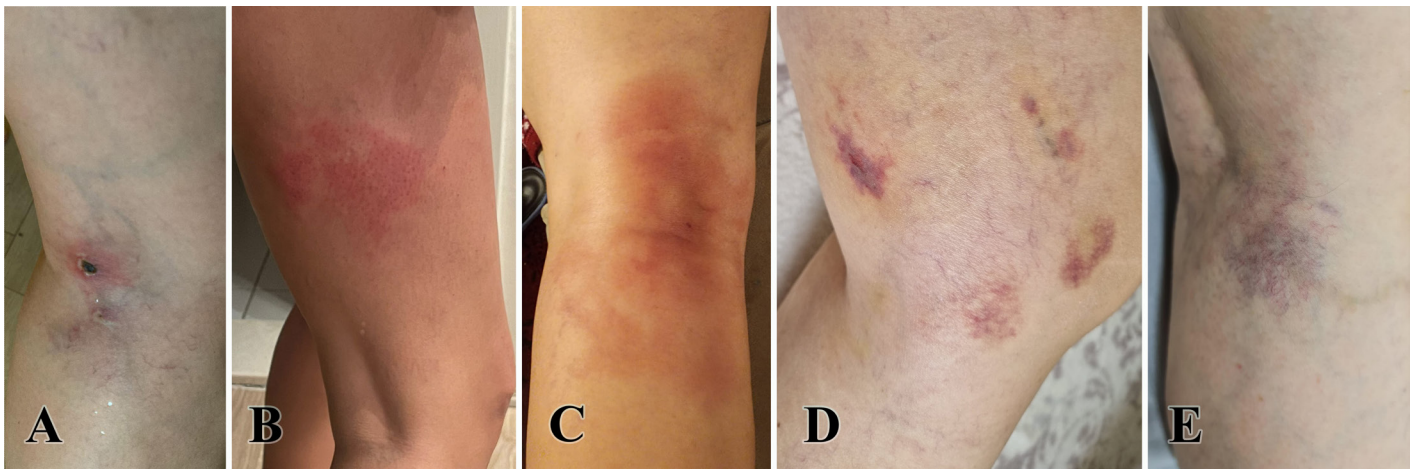

Figure 2. Representative clinical photographs of post-procedural complications observed after liquid polidocanol sclerotherapy. (A) Skin necrosis. (B) Erythema. (C) Hyperpigmentation. (D) Ecchymosis. (E) Matting

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Table 1. Baseline demographic characteristics and patient- and session-based complication rates

Variable	Per-patient rate n (%)	Per-session rate (%)
Number of patients	153	—
Total number of sessions	779	—
Age, years (mean ± SD)	41.35 ± 8.05	—
Number of sessions (mean ± SD)	5.09 ± 3.22	—
Number of sessions, median (range)	5 (1–26)	—
Ultrasound-detected insufficiency, n (%)	18 (11.8)	—
Any complication, n (%)	55 (35.9)	7.1
Ecchymosis, n (%)	25 (16.3)	3.2
Erythema, n (%)	31 (20.3)	4.0
Localized pain, n (%)	16 (10.5)	2.1
Matting, n (%)	5 (3.3)	0.6
Pruritus, n (%)	4 (2.6)	0.5
Persistent hyperpigmentation, n (%)	1 (0.7)	0.1
Transient hyperpigmentation, n (%)	3 (2.0)	0.4
Skin necrosis, n (%)	3 (2.0)	0.4
Thrombophlebitis, n (%)	1 (0.7)	0.1
Deep vein thrombosis, n (%)	0 (0.0)	0.0
Anaphylactic reaction, n (%)	0 (0.0)	0.0
Severe tissue necrosis, n (%)	0 (0.0)	0.0
Stroke and transient ischemic attack, n (%)	0 (0.0)	0.0
Vision problems, n (%)	0 (0.0)	0.0
Headaches and migraines, n (%)	0 (0.0)	0.0
Chest tightness, n (%)	0 (0.0)	0.0
Dry cough, n (%)	0 (0.0)	0.0

Continuous variables are presented as mean ± standard deviation; Categorical variables are presented as number (%)

Table 2. Comparison of patients with and without complications

Variable	No complication (n = 98)	Any complication (n = 55)	p value
Age, years	41.4 ± 8.1	41.1 ± 8.1	0.861
Number of sessions, mean ± SD (median)	4.5 ± 2.7 (5.0)	6.1 ± 3.8 (6.0)	0.011*
Ultrasound-detected insufficiency, n (%)	12 (12.4)	6 (10.9)	0.804
Prior surgery, n (%)	6 (6.1)	4 (7.3)	1.000
Fitzpatrick skin type II/III/IV	3/38/57	3/22/30	0.794

* Values are presented as mean ± standard deviation or number (%); The Mann–Whitney U test was used for the comparison of number of sessions because of non-normal distribution; Other continuous variables were compared using the independent-samples t-test; Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate

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Table 3. Association between ultrasound-detected venous insufficiency and post-procedural complications

Complication	Insufficiency absent (n = 134)	Insufficiency present (n = 18)	p value
Skin necrosis, n (%)	3 (2.2)	0 (0.0)	1.000
Erythema, n (%)	28 (20.9)	3 (16.7)	0.768
Matting, n (%)	5 (3.7)	0 (0.0)	0.635
Thrombophlebitis, n (%)	1 (0.7)	0 (0.0)	1.000
Ecchymosis, n (%)	21 (15.7)	4 (22.2)	0.500
Localized pain, n (%)	14 (10.4)	2 (11.1)	1.000
Pruritus, n (%)	4 (3.0)	0 (0.0)	1.000
Persistent hyperpigmentation, n (%)	1 (0.7)	0 (0.0)	1.000
Any complication, n (%)	49 (36.6)	6 (33.3)	0.804

Categorical variables are presented as number (%); Chi-square or Fisher's exact test was used according to expected cell counts

Table 4. Binary logistic regression analysis for predictors of any complication

Variable	B	Exp(B) (OR)	95% CI	p value
Number of sessions	0.199	1.221	1.070 – 1.393	0.003
Age	-0.011	0.990	0.943 – 1.039	0.672
Ultrasound-detected insufficiency	-0.110	0.896	0.260 – 3.083	0.861
Prior surgery	0.286	1.331	0.278 – 6.383	0.721

Omnibus test p = 0.020; Hosmer–Lemeshow test p = 0.157; Nagelkerke R^2 = 0.101

Discussion

The present study evaluated the safety profile of liquid polidocanol sclerotherapy and factors associated with complication development in patients treated for superficial venous disorders. The main findings were as follows: liquid polidocanol sclerotherapy demonstrated a favorable safety profile with no major systemic or neurological complications observed; most complications were minor and self-limiting; and the number of treatment sessions emerged as the only independent predictor of complication development. In contrast, age, ultrasound-detected venous insufficiency, prior surgical history, and Fitzpatrick skin type were not significantly associated with complication risk.

Sclerotherapy is widely used for telangiectatic and reticular venous disease because of its outpatient feasibility, low cost, favorable cosmetic outcomes, and ease of application [2,12]. Although generally considered safe, both local and systemic adverse events have been reported, ranging from transient erythema to rare neurological and thromboembolic complications [14,15]. In the present study, no cases of deep vein thrombosis, anaphylaxis, stroke, transient ischemic attack, visual disturbance, chest tightness, or dry cough were observed, supporting the favorable systemic safety profile of liquid polidocanol sclerotherapy when standardized low-volume and low-pressure injection techniques are used.

Approximately one-third of patients developed at least one complication; however, all complications were minor. The most common adverse events were erythema, ecchymosis, and localized pain, consistent with previous reports identifying transient inflammatory and traumatic local reactions as the most frequent complications after sclerotherapy [2,14,16,17]. Severe tissue injury was not observed, and cases of skin necrosis were limited and self-limiting. The relatively low rates of severe local complications may be related to the use of fine-caliber needles, low-pressure injection techniques, standardized compression therapy, and careful sclerosant dose limitation.

Hyperpigmentation and telangiectatic matting are among the most cosmetically concerning complications after sclerotherapy, with reported rates varying according to sclerosant concentration, vessel diameter, follow-up duration, and patient characteristics [18–22]. In the present study, both persistent hyperpigmentation and matting were relatively uncommon. Routine compression therapy, post-procedural anti-inflammatory treatment, procedural standardization, and early drainage of retained microthrombi in selected patients may have contributed to these favorable cosmetic outcomes.

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One of the most clinically relevant findings was the independent association between the number of treatment sessions and complication development. Patients with complications underwent significantly more treatment sessions, and each additional session increased complication risk by approximately 22% in multivariable analysis. Although repeated sessions are often necessary to achieve satisfactory cosmetic outcomes, the impact of cumulative procedural burden on complication risk has received limited attention. Repeated endothelial injury, recurrent inflammatory responses, and cumulative microvascular trauma may contribute to increased susceptibility to adverse effects, suggesting that cumulative procedural exposure itself may be an important determinant of complication development.

Ultrasound-detected venous insufficiency was not significantly associated with either individual complications or overall complication development. This differs from some previous reports suggesting that venous reflux may predispose patients to adverse vascular remodeling and unfavorable cosmetic outcomes after sclerotherapy. However, the relatively small number of patients with significant duplex ultrasound-detected insufficiency and the use of adjunctive truncal venous interventions before sclerotherapy may partially explain this finding. Similarly, neither age nor prior surgical history was associated with complication risk, suggesting that procedural factors may be more important determinants of complications than baseline demographic characteristics.

Standardized compression therapy was routinely applied after treatment. Although its independent effect could not be evaluated in the present study, compression therapy may have contributed to the relatively favorable complication profile observed in our cohort. By promoting apposition of the treated vein walls and facilitating earlier vein collapse, compression may reduce intraluminal thrombus retention and the subsequent inflammatory response. These mechanisms have been proposed to decrease the risk of thrombotic complications as well as cosmetic sequelae such as hyperpigmentation and telangiectatic matting following sclerotherapy [2,20,23].

Conclusion

Liquid polidocanol sclerotherapy demonstrated a favorable safety profile in the treatment of superficial venous disorders, with no major systemic or neurological complications observed. Most complications were minor, transient, and cosmetically limited. Importantly, the number of treatment sessions emerged as the only independent predictor of complication development, suggesting that cumulative procedural exposure may play a clinically relevant role in post-treatment adverse events. In contrast, ultrasound-detected venous insufficiency, age, prior surgical history, and skin type were not significantly associated with complication risk. These findings highlight the importance of careful procedural planning, session scheduling, and meticulous injection technique in minimizing complications during routine sclerotherapy practice.

Limitations

The present study has several limitations. First, its retrospective single-center design may limit the generalizability of the findings. Second, the relatively limited sample size, particularly for rare complications, restricted detailed subgroup analyses of individual adverse events. Third, all procedures were performed in a single clinical setting, and therefore the results may partially reflect operator-dependent and institutional factors. In addition, only liquid polidocanol sclerotherapy was evaluated, limiting direct generalizability to foam sclerotherapy or other sclerosant agents. Finally, although repeated treatment sessions were associated with complication development, residual confounding related to disease severity and treatment burden cannot be completely excluded. Nevertheless, the study provides clinically relevant real-world data regarding complication patterns and predictors following liquid polidocanol sclerotherapy.

Ethical Approval

This study was approved by the Non-Interventional Scientific Research Ethics Committee of Gülhane Training and Research Hospital, University of Health Sciences, with decision number 2025/38 dated 06.02.2025. In order to increase the sample size, an amendment was submitted to extend the patient inclusion period, which was approved by the ethics committee and the study was accordingly updated on 02.04.2026. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent revisions.

Patient Consent

Due to the retrospective design of the study and the use of anonymized patient data, the requirement for written informed consent was waived by the ethics committee.

Conflict of Interest

The authors confirm the absence of any conflicts associated with this work.

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