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INTRODUCTION

Chronic venous insufficiency is a significant health issue that affects a large portion of the population, leading to reduced quality of life and increased healthcare expenditures (1). Traditional surgical methods have largely been replaced by endovenous treatments, which are becoming more prevalent in clinical practice.

Comparing radiofrequency ablation and N-Butyl Cyanoacrylate for the treatment of superficial venous incompetence

Abstract

Aim: Superficial venous incompetence represents a significant health concern affecting a substantial portion of the population, often leading to diminished quality of life and increased healthcare costs. The traditional surgical approaches have increasingly given way to minimally invasive endovenous treatments, which have become standard practice in many clinical settings. These treatments aim to either thermally ablate the affected veins using energy sources like radiofrequency (RFA) or occlude them with adhesives such as N-Butyl Cyanoacrylate (NBCA), thereby restoring venous function.

Material and Methods: This study retrospectively reviewed data from patients treated between 2021 and 2024 for great saphenous vein incompetence using RFA (VNUS® ClosureFAST) and NBCA (VenaBLOCK). A total of 80 patients met inclusion criteria, with 40 in each treatment group. Preoperative evaluations included demographic data, CEAP classification, and vein diameter, while perioperative data encompassed procedural duration and patient-reported discomfort. Postoperative outcomes examined included analgesic use, complications (notably phlebitis), hospital stay duration, and vein closure rates at 6 months.

Results: Study results indicated comparable efficacy between RFA and NBCA in achieving vein closure, with occlusion rates of 94.2% and 92.1%, respectively. The NBCA group demonstrated significantly shorter procedural times and hospital stays compared to RFA, reflecting the advantages of using a non-thermal, adhesive-based approach under local anesthesia. However, both methods showed minimal postoperative complications, primarily consisting of superficial phlebitis localized at the puncture site.

Conclusion: In conclusion, both RFA and NBCA present viable options for treating superficial venous incompetence, offering satisfactory outcomes with acceptable complication rates, albeit with procedural differences that should be weighed against patient-specific factors and institutional capabilities. Future research should focus on expanding these findings through rigorous prospective investigations to further refine clinical practice and enhance patient care.

Keywords: Superficial venous insufficiency, N-Butyl Cyanoacrylate, radiofrequency ablation

While some clinics continue to utilize traditional surgical excision, the contemporary treatment of chronic venous insufficiency has predominantly shifted towards endovenous therapies. These therapies are based on the principle of either internally damaging the vein using high energy or occluding it by internal closure with adhesives (2,3).

Endovenous treatments can be categorized into thermal and non-thermal ablation methods. Thermal methods involve ablating the

inner surface of the vein using various endovenous heat sources. Radiofrequency ablation (RFA) is one of the commonly used thermal treatment methods. Tumescence anesthesia is necessary in RFA procedure to prevent the high-energy source from damaging the surrounding tissues. In contrast, non-thermal ablation methods involve the internal occlusion of the vein using chemical compounds. N-Butyl Cyanoacrylate (NBCA) is one of the commonly used non-thermal treatment methods. Since the chemical agent used in non-thermal methods poses no risk to surrounding tissues during the procedure, tumescence anesthesia is not required.

This study aims to compare the preoperative, perioperative, and postoperative outcomes of patients with superficial venous incompetence treated with thermal RFA and non-thermal NBCA techniques.

MATERIAL AND METHODS

The study was approved by Malatya Turgut Özal University Health Sciences Non-invasive Clinical Research Ethics Committee, and informed consent form obtained from the participants. The data of patients treated for superficial venous incompetence with RFA and NBCA closure methods between 2021 and 2024 were retrospectively reviewed from hospital records. The diagnosis of superficial venous incompetence was made by physical examination and doppler USG. Patients younger than 18 years old, those with prior use of other invasive treatments, secondary varicose veins, hypercoagulable conditions, or deep venous system obstructions were excluded.

Total of 98 patients with superficial venous insufficiency were identified. The first 40 patients who met the inclusion criteria for each group and were operated on with either RFA or NBCA were included in the study in chronological order. 18 patients were excluded from the study due to not meeting the inclusion criteria. The average follow-up period of the patients was 12 months.

Demographic data such as age and gender were obtained from the hospital database. Preoperative characteristics of the patients, including CEAP classification, the leg to be treated, the vein to be treated, and the preoperative diameter of this vein, were collected. Perioperative information from the patients, including pain experienced during the surgery and the duration of the operation, was collected. Postoperative characteristics of the patients, including daily analgesic requirement, postoperative complications, length of hospital stay, time to return daily routine, and venous closure rates at 6 months postoperatively were collected.

Procedures

The superficial vein of the patients was evaluated by doppler ultrasonography (DUS). The operative criteria for superficial vein incompetence included a great saphenous vein (GSV) diameter exceeding 5.5 mm, measured two centimeters below the saphenofemoral junction with the patient in a standing position, in conjunction with reflux lasting more than 2 seconds, as per

the ESVS guideline (4). The surgical technique was decided by the patient and the physician who will perform the procedure together.

RFA

The procedure was performed using a ClosureFast catheter (VNUS® ClosureFAST, Covidien, Dublin, Ireland) in accordance with the manufacturer's instructions and as previously documented in the literature (5). After spinal anesthesia, a tumescence anesthesia mixture was prepared, consisting of 20 mL of 2% prilocaine, 500 mL of physiological saline solution, 20 mL of 8.4% sodium bicarbonate, and 0.5 mg of adrenaline. Tumescence local anesthesia was administered to the saphenous compartment surrounding the vein.

NBCA

Endovenous closure was performed using the VenaBLOCK, (Invamed, Türkiye). After inserting the 6F sheath, a 0.035-inch × 150 cm guidewire was advanced to the saphenofemoral junction (SFJ), and its position was confirmed by duplex ultrasound (DUS). Delivery catheter was placed 3 cm distal to the junction. Following confirmation, NBCA was injected into the entire target vessel at a rate of 0.03 mL per cm while the catheter was withdrawn at a rate of 2 cm/s by applying continuous pressure on the vessel.

After both RFA and NBCA, compression therapy was administered. Initially, an elastic compression bandage was applied for one day, followed by wearing a Class II compression stocking for one month. Anticoagulant therapy was not administered to any patient before or after the procedure.

Statistical Analysis

The study data were analyzed using SPSS (Statistical Program in Social Sciences) 25 program. Normality tests were performed to determine the appropriate statistical methods—parametric or non-parametric. The Kolmogorov-Smirnov test was used to assess normal distribution ($p=0.05$) (6). Descriptive statistics included numbers and percentages for variables. Parametric data were presented with mean and standard deviation, while non-parametric data were presented with median and quartile range. Homogeneity of variances was checked using Levene's test ($p>0.05$). Independent sample comparisons used t-tests for normally distributed data and Mann-Whitney tests for non-normally distributed data. Categorical data were analyzed using chi-square tests, with phi coefficient (ϕ) for 2x2 tables and Cramer's V for larger tables.

RESULTS

Pre and perioperative characteristics of the patients are shown in Table 1. The ages of patients in the RFA group were 46.53 ± 11.85 years, while the ages of patients in the NBCA group were 47.38 ± 10.74 years. The RFA group included 26 male patients, and the NBCA group included 22 male patients. The majority

of the patients in both groups were classified as CEAP 3. The average vein diameter was 9.13 ± 2.90 mm in the RFA group and 9.31 ± 2.14 mm in the NBCA group. Most of the legs with venous insufficiency that were operated on in both groups were left legs. According to the study data, statistically significant differences were not found between the pre and perioperative characteristics of both groups, except for the duration of the procedure. In the RFA group, the duration of the procedure was 47.3 ± 7.8 minutes, whereas in the NBCA group, it was 17.3 ± 5.9 minutes ($P=0.03$).

The postoperative data of the patients are presented in Table 2. The majority of patients in both groups reported experiencing mild discomfort during the procedure. Similarly, postoperative

analgesic requirement was minimal in both groups, with most patients requiring only one analgesic per day. Postoperative complications such as bleeding and DVT were not observed. Superficial phlebitis was noted in 4 patients in the RFA group and 7 patients in the NBCA group. The main difference between the groups was observed in the length of hospital stay, with an average of 29.50 ± 2.79 hours in the RFA group compared to 6.83 ± 1.42 hours in the NBCA group ($P=0.001$). However, the time taken for patients to return to their daily routines after discharge was similar in both groups. When the 6-month control USG reports of the patients were examined, GSV occlusion rates were 94.2% in the RFA group and 92.1% in the NBCA group, with no statistically significant difference observed.

Table 1. Pre and perioperative characteristics of patients

	RFA (n, %)	NBCA (n, %)	p
Sex			0.36
Male	26, (65.00)	22, (55.00)	
Female	14, (35.00)	18, (45.00)	
Age (year)	46.53 ± 11.85	47.38 ± 10.74	0.72
Legs undergoing procedures			0.26
Right	15, (37.50)	17, (42.50)	
Left	25, (62.50)	23, (57.50)	
CEAP			0.41
3	21, (52.50)	23, (57.5)	
4	16, (40.00)	16, (40.00)	
5	3, (7.5)	1, (2.50)	
Vein Diameter (mm)	9.13 ± 2.90	9.31 ± 2.14	0.79
Duration of procedure (min)	47.3 ± 7.8	17.3 ± 5.9	0.03

RFA: radiofrequency ablation, NBCA: N-butyl cyanoacrylate

Table 2. Postoperative characteristics of patients

	RFA (n, %)	NBCA (n, %)	p
Pain felt during the procedure			0.59
Mid pain	32, (80.00%)	30, (75.00%)	
Moderate	8, (20.00%)	10, (25.00%)	
Severe	-	-	
Number of analgesics used daily			NS
Once a day	31, (77.50%)	31, (77.50%)	
Twice a day	9, (22.5%)	9, (22.50%)	
Postoperative complication			0.33
DVT	-	-	
Bleeding	-	-	
Phlebitis	4, (10.00%)	7, (17.5%)	
Length of hospital stay (h)	29.50 ± 2.79	6.83 ± 1.42	0.001
Return to daily rutin (d)	1.23 ± 0.12	1.28 ± 0.81	0.43

RFA: radiofrequency ablation, NBCA: N-butyl cyanoacrylate, DVT: deep vein thrombosis

DISCUSSION

In our study comparing the two most commonly used endovenous treatments for superficial venous incompetence at our hospital, the most significant finding was the difference in procedural duration and hospital stay between the two methods. Patients undergoing RFA exhibited significantly longer procedural durations and hospital stays compared to other methods.

RFA operates on the principle of internally heating the vein. One of the significant disadvantages of heating the vein internally is that the heat generated during the procedure can cause pain and lead to unwanted damage to surrounding tissues. Therefore, all patients undergoing RFA receive either spinal anesthesia or general anesthesia. However, both types of anesthesia increase the total procedural time in RFA due to their application durations. While spinal anesthesia is generally considered safe, it can still result in undesired side effects post-procedure. In addition to mild adverse effects such as headache, hypotension, difficulty urinating, nausea, and vomiting, spinal anesthesia can also lead to rare but serious side effects like respiratory depression, neuropathy, severe paresthesia, and infection (7). Difficulty in urination due to spinal anesthesia is particularly common in elderly male patients. The use of a urinary catheter can resolve this issue; however, it may lead to pain, dysuria, and urinary tract infection (8). The longer duration of spinal anesthesia compared to local anesthesia results in extended postoperative mobilization and discharge times for patients. In our study, patients undergoing RFA were found to require an additional day of hospital stay compared to those treated with NBCA. Due to its administration under local anesthesia and did not require tumescent anesthesia, NBCA was found to have a shorter procedural duration. However, performing the procedure under local anesthesia, especially during distal vein puncture, can present challenges in terms of patient cooperation.

The most important success criterion of treatment of superficial venous incompetence is the closure rate of the target vein. In the, both methods have demonstrated satisfactory results in achieving closure. GSV occlusion rates were 94.2% in the RFA group and 92.1% in the NBCA group. In the literature, short term occlusion rates ranging from 90% to 100% have been reported for RFA, 90.3% and 98% for NBCA (9-15). Our results are similar to the literature, and it is seen that both treatment strategy give satisfactory results.

In the literature, complications of endovenous treatment for superficial venous insufficiency include pulmonary embolism, deep vein thrombosis (DVT), bleeding, paresthesia, pigmentation, phlebitis, and bruising (16). When comparing both treatment methods in terms of complications, no complications were observed in either group except for phlebitis. Although there was no statistical difference, the number of phlebitis cases in the NBCA group was higher than in the RFA group. All instances of phlebitis in the NBCA group occurred at the venous puncture site, suggesting that this might be due to the extravasation of

NBCA into the surrounding tissues.

The most significant limitation of our study is its retrospective design and the limited number of patients. Additionally, the lack of long-term follow-up of the patients is another limitation of our study. Prospective studies with larger sample sizes will enrich the literature in this field.

CONCLUSION

In conclusion, the data obtained from our study demonstrate that the treatment of superficial venous insufficiency performed in our clinic using both RFA and NBCA methods yields satisfactory results with acceptable complication rates. Although both techniques are frequently used in our clinic, methods that minimize procedure time and hospital stay are more preferred due to the high patient turnover rate.

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Ethics Committee Approval: Approved by Malatya Turgut Özal University Health Sciences Non-invasive Clinical Research Ethics Committee, Number of Decisions: 2024/324.

Patient Informed Consent: Informed consent form was obtained from the participants.

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