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Comparison of pain during endovenous laser ablation of the great saphenous vein with ultrasound-guided femoral nerve block with local anesthesia

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Abstract

Aim: The endoluminal laser ablation technique is used to treat greater saphenous vein insufficiency. Endovenous laser ablation may be associated with significant pain when performed under standard local tumescent anesthesia. The purpose of this study was to investigate the efficacy of femoral nerve blocks for analgesia during endovenous ablation in patients with lower extremity venous insufficiency.

Materials and Methods: Sixty-seven patients of ASA physical status I and II, with ages ranging between 29 and 55 years, and who underwent endovenous laser ablation due to greater saphenous vein insufficiency were retrospectively analyzed. All patients received tumescent anesthesia (TA). However, one group received a femoral nerve block (FNB) under ultrasound-guidance before the procedure. The FNB (n=34) was performed at the level of the inguinal ligament, by injecting 20 ml of 0.5% bupivacaine solution under ultrasound-guidance. After the blocks, endovenous laser ablations and other treatments were performed in the standard manner. After the procedures, a visual analogue pain scale (VAS) values of patients were collected from records for pain assessment. The VAS, volume of TA solution, mean heart rate, mean arterial pressures, nause-vomiting and additional consumption of analgesics were recorded at postoperative 0,1,2,4 and 6h, respectively.

Results: Postoperative mean heart rate, arterial pressure and nause-vomiting did not differ between the groups ($p>0.05$). While the perioperative VAS values were<4 in the Group FNB, it was observed that the VAS score increased above 5 in the Group LA. The Group LA were required an additional analgesic agent. The volume of TA solution was lower in Group FNB, 250($\pm$57) mL, compared to 376($\pm$121) mL in Group LA ($p<0.001$). There was no significant difference between the two groups in the length of the great saphenous vein (GSV) or procedure duration.

Conclusion: In conclusion, ultrasound-guided FNB was shown to be a safe and effective option to decrease additional analgesic requirement and intraoperative discomforts associated with TA and endoluminal laser ablation of the GSV.

Introduction

The chronic venous insufficiency is often observed in the adult population. Varicose veins that develop due to chronic venous insufficiency are mostly formed as a result of great saphenous vein (GSV) insufficiency, but can also be caused by insufficiency of the superficial veins of the lower extremities. The treatment modalities for varicose veins are conservative treatment, minimally invasive procedures and surgical techniques. In order to eliminate reflux, which has recently developed due to venous insufficiency, minimally invasive procedures, such as the endovenous laser ablation (EVLA) method, are recommended to be performed according to surgical procedures. This procedure is a typically performed in the outpatient surroundings and patient was discharged home a few hours after the procedure is complete. It is stated that it is an effective treatment method that provides the patient with the advantage of earlier mobilization, less morbidity, faster recovery and better cosmetic results [1,2].

The EVLA technique is based on the creation of thermal damage to the vascular endothelium by surgeons to treat GSV insufficiency. GSV is deactivated using thermal energy. This method occurs direct thermal injury to endothelium and consequenntly vessel occlusion. EVLA method applications are performed with tumescent anes-

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thesia (TA) in order to prevent normal tissues from being affected and damaged by the heat generated during laser ablation therapy and to reduce the pain caused during the procedure [1-6]. Since TA requires injection applications at many different points along the large and small venous saphenous vein tract, it may cause pain that patients cannot tolerate and may reduce the quality of the procedure. While the severity of the pain may be "tolerable" for some patients, it can be quite a "bad experience" for most patients. The pain can be severe, especially due to the venous spasm that develops during catheterization. For this reason, the EVLA procedure is performed together with many anesthesia methods [7]. The most of physicians' utilizeocal anesthesia for needle punctures and TA to prevent pain and maintains the surrounding tissues from the conduction of heat that would originate from the effects of laser energy on the venous wall. One of the most important parameters when choosing an anesthesia method is that it can allow early mobilization. Because the delay in mobilization can cause undesirable complications such as deep vein thrombosis [3,5].

The during EVLA are applicated during anesthesia methods such as conscious sedation, local anesthesia, femoral nerve block, sciatic nerve block, combined nerve blocks, neuroaxial blocks or general anesthesia to patients. The general anaesthesia has side effects such as vomiting, nause, difficult airway management, sore throat and myalgia; neuroaxial blocks have side effects such as headache, hypotension, hematoma, infection; conscious sedation has side effects such as respiratory depression and length of the time of discharge [2-6].

The femoral nerve block (FNB) performed using ultrasonography is expressed as a method that can be applied technically in a brief moment is easy has a low risk of complications and is quite effective in relieving discomfort due to TA [5,8]. The anterior branches of the femoral nerve sartorius muscle and the lumbar plexus from the front face of the quadriceps muscle of the femur below the branches, while its rear, the knee joint and the knee and the inner pressure in the vena saphena below provides malleol of the region in parallel with the skin down. FNB therefore allows minimally invasive or conventional surgical procedures to be performed on GSV [9].

The aim of the investigation is to compare the effects of USG guided FNB with TA or LA with TA on intraoperative analgesia, postoperative analgesia, haemodynamic parameters and after EVLA procedures with endovenous laser in patients with GSV of the lower extremity according to the h1 hypothesis.

Materials and Methods

This study has been done after receiving Elazig Fırat University Non-Interventional Research Ethics Committee (Session number: 2022/ 08-19), between January 2021 and April 2021, cardiovascular surgery operating room of Elazig Fethi Sekin City Hospital for unilateral varicose vein surgery in the lower extremity due to saphenous vein insufficiency, EVLA technique accompanied by TA. The patients who underwent surgery were reviewed retrospectively. In all of them patients, there were typical symptoms and signs of chronic venous insufficiency, and color Doppler USG demonstrated incompetence of the GSV. The patients aged between 29 and 55, with American Society of Anesthesiologists (ASA) physical status I and II, and who had undergone FNB or intradermal LA before EVLA were included in the study. Patients who were treated with general anesthesia, a different block or a combined block, diagnosed with diabetes or had neuropathy were excluded from the study and 67 patients were included in the study. Because a number of patients were determined by power analysis, which suggested minimum of 64 individuals with an alpha error of 0.05 and a beta error of 0.10 (power=0.90).

The cases included in the study were started with an infusion of 0.9% NaCl solution (10 mL h^{-1}) through an 18 G venous cannula placed on the forearm in the operating room of cardiovascular surgery. The cases were determined as FNB Group (n=34) and intradermal LA Group (n=33). All cases were given midazolam (0.05 mg kg^{-1}) intravenous (IV) for sedation and peripheral hemoglobin oxygen saturations (SpO_2) were monitored by pulse oximetry, noninvasive arterial pressures and heart rate and rhythm were monitored by electrocardiogram (ECG) on the operating table. After inguinal region antisepsis was performed in supine position, a linear transducer (Philips-Healthcare, L22-2 probe, North America, Cambrige, USA) was held transversely at the level of the inguinal ligament and the common femoral artery and femoral vein tract were visualized. The triangular area formed by the iliopsoas muscle, fascia iliaca and common femoral artery lateral to the common femoral artery was visualized. The tip of the block needle (50mm, Braun ®, Melsungen AG, Germany) was advanced under the fascia iliac by in-plane technique. Immediately after a negative aspiration test, 20 ml of 0.5% bupivacaine (Marcaine® 0.5% bupivacaine hydrochloride, 20 ml/100 mg vial, AstraZeneca Ltc., Istanbul, Turkey) solution was injected and FNB was performed. In the cases where only intradermal local anesthesia was performed, a total of 20 ml of 0.5% bupivacaine was administered intradermal to the varicose areas where the procedure was performed. The effectiveness of the block was confirmed by performing a pinprick test in the innervation zone of the femoral nerve. After the patients were taken to the operating room, the duration of anesthesia and surgical procedures were recorded, and the effectiveness of local anesthesia was comparised in patients who underwent FNB with TA or LA with TA alone.

The EVLA procedure was performed in all cases by the same cardiovascular surgeon in a standard way. Laser ablation treatment was applied to the varicose GSV with 600 or 400 µm diameter laser fibers with a wavelength of 1064 nm (Nd-YAG, Quantum Composers Inc, USA). Venous filling was achieved by placing the patients in the reverse trendelenburg position. TA (lidocaine diluted with isotonic 0.04% = 400 mg L^{-1} + 10 mEq L^{-1} sodium bicarbonate + 1 mg L^{-1} adrenaline) was applied to the periphery of the venous structure to be laser ablated, accompanied by USG. GSV was determined by colored Doppler USG in the medial of the knee, the GSV was entered with a 7F sheath, and the saphenofemoral junction (SFJ) was detected, and the EVLA procedure was performed by advancing laser fibers through the sheath up to 1 cm distal

to the junction. External compression was applied to the legs after the procedure.

Visual Analogue Scale (VAS) for pain assessment after procedures, [0; no pain, 10; unbearable pain] had been used. The VAS value was aimed to be ≤4. If the VAS score was above 4, additional analgesics administered to patients were obtained from records. 1 µg kg^{-1} IV fentanyl (Talinat®, VEM İlaç A.Ş, Istanbul, Turkey) were used as an additional analgesic in the intraoperative period, and tramadol (Tramosel®, HAVER FARMA Ilac A.Ş, Istanbul, Turkey) maximum 400 mg $daily^{-1}$ in the postoperative period. GSV length, TA solution volume and duration of the procedure had been obtained from records. Mean heart rate (HR), mean arterial pressure (MAP) had been measured at 5-minute intervals after the block, additional analgesic consumption and nausea-vomiting score had been recorded simultaneously. VAS scores had been recorded at the time of admission to the postoperative care unit (PACU) and at 1, 2, 4, and 6 hours postoperatively. The nausea-vomiting complaints of the cases had been evaluated with the nausea-vomiting score (1. No nausea, 2. There was mild nausea, 3. There was severe nausea, 4. There was vomiting), if the nausea-vomiting score is 2 and above, 10 mg metoclopramide Hcl (Metpamide) ® 10 mg/2 ml ampoule, Sifar İlaç A.Ş., Istanbul, Turkey) had been applied. Additional analgesic and antiemetic drug doses consumed during the follow-up period had been recorded. The patients with stable hemodynamics had been discharged after 20-25 minutes of walking in the follow-up of the service nurse. To measure the satisfaction level of patients (on discharge) and surgeons (postsurgery), a 7-point verbal Likert Scale had been used and their evaluation of the procedure [1: Extremely dissatisfied, 7: Extremely satisfied] had been recorded.

Statistical analysis

Statistical analysis was performed using SPSS 26.0 (International Business Machines Corporation, USA) software. Data were given as number of cases (N) or mean±standard deviation (SD). Normal distribution was tested with the Kolmogorov-Smirnov test. In comparisons between groups, Student's t-test was used for data between groups with normal distribution, and Mann-Whitney U test and median (interquartil range) were used for non-normal distributions. Friedman test and Wilcoxon test with Bonferroni correction were used as post hoc tests for in-group multiple comparisons. ANOVA test was used to test VAS pain score, postoperative hospital stay, patient and surgeon satisfaction score. Chi-square test was used for categorical variables. $P<0.05$ was considered statistically significant.

Results

The data of 67 patients were collected. The cases in the groups, there was no statistically significant difference between demographic characteristics, comorbidities, ASA physical conditions, and procedure locations ($p>0.05$) (Table 1). The procedure time of Group FNB was 42.7±6.6 minutes, and 37.6±6.2 significantly longer than Group LA ($p=0.03$). While the volume of TA solution was 376 (±121) mL in Group LA, it was lower in Group FNB as 250 (±57) mL ($p<0.01$). There was no significant difference between the GSV lengths of both groups ($p>0.05$) (Table 2). A statistically significant difference was found between the two study groups in the measurements made using VAS in the application of TA and during the operation; where the LA group had more severe pain than the FNB group ($p<0.01$). The pain scores in the VAS were 0 in all patients during the process in the group applied FNB.

Table 1. Demographic characteristics of patients and anatomical (surgery side) EVLA procedure applications.

Parameters	Group FNB (n=34)	Group LA (n=33)	p values
Gender			
Female	24 (70.59%)	22 (66.66%)	0.58†
Male	10 (29.41%)	11 (33.34%)	
Age (years)	38.2±11.2	37.6±13.7	0.83
Length (cm)	165.7±8.6	161.1±6.7	0.72
Weight (kg)	72.1±11.5	71.6± 9.5	0.67
BMI (kg/m²)	24.5±3.8	27.2±4.2	0.43
Comorbidity			
Hypertension	1	1	
CAD	2	2	0.51
Obesity	1	1	
ASA I/II	27/7	25/8	0.91
Surgery side (right/left)	(15/19)	(18/15)	0.18

Data are presented as mean (SD): (mean±standard deviation) or †number; Chi-square test/Independent sample t test; BMI = Body mass index; CAD=Coronary Artery Disease; ASA=American Society of Anesthesiologists.

Table 2. Comparison of processing times, spent in recovery time, amount of tumescent solution, GSV lengths and additional analgesic consumption of study groups.

Parameters	Group FNB	Group LA	p values
Processing time (minutes)	42.7±6.6	37.6±6.2	0.03*
Spent in recovery time (minutes)	18.4±2.6	18.7±2.6	0.68
Tumescent solution (ml)	250 (±57)	376 (±121)	0.001*
GSV length	41 (32-51)	39 (34-50)	0.59≈
Total tramadol (mg)	152 ± 59.4	218 ±57.1	0.01*

Data are presented as mean (SD):(mean±standard deviation) or medyan (interquartil range) ≈; GSV:Great saphenous vein.

Table 3. Comparison of the VAS scores of the study groups over time.

Values	Group FNB (n=34)	Group LA (n=33)	p value
PACU	1.15±1.01	3.65±1.62	<0.001
1st hour	1.24 ±1.03	3.75 ±1.82	<0.001
2nd hour	1.41±1.27	4.01±1.75	<0.001
4th hour	1.57±1.33	3.37±1.66	<0.001
6th hour	1.97±1.67	3.83±1.86	<0.001

Data are presented as mean (SD): (mean±standard deviation); PACU:Postoperative care unit.

Table 4. Comparison of preoperative, perioperative and postoperative mean arterial pressure and heart rate of study groups.

Parameters	Preoperative	After FNB or LA			Postoperative		
		5th min	15th min	30th min	45ht min	60th min	*p value
MAP (mmHg)							
Group FNB	83±12	82±8	81±7	79±10	81±9	82±11	0.3
Group LA	84±11	83±9	82±8	81±11	81±13	83±10	0.2
CBG	0.6	0.6	0.7	0.6	0.6	0.7	
HR (pulse min^{-1})							
Group FNB	75±8	74±7	75±9	74±11	75±10	76±6	0.7
Group LA	77±6	75±8	76±10	74±9	76±9	78±7	0.6
Intergroup comparison	0.8	0.7	0.8	0.7	0.7	0.7	

MAP: mean arterial pressure; min: minute; HR: Heart rate; SD: standard deviation; CBG: comparison between groups; Mann–Whitney U-test. *p: intergroup comparison; Friedman test, Bonferroni-corrected Wilcoxon test.

Table 5. Comparison of the nausea-vomiting, patient and surgeon satisfaction scores of the study groups.

Values	Group FNB (n=34)	Group LA (n=33)	p value
Nausea-vomiting	1 (2.64%)	1 (3.03%)	0.897
Patient satisfaction score	7 (6-7)	4 (3.5-4)	<0.001
Surgeon satisfaction score	7 (6-7)	4 (3-4)	<0.001

Data are presented as number (%) or median (interquartile range).

In group LA, pain (VAS>4) was felt in 4 (12%) patients in the first puncture of the GSV. The guide wire was admitted to advance through the needle painlessly by appliying TA to the region. Because of the failure to alleviate the pain for three of the patients of these patients in LA group, 0.1 µg IV fentanyl was performed. It was observed that the postoperative VAS score was <4 in the FNB group, while it increased above 5 in the other group (Table 3). Patients who underwent TA and intradermal LA required an additional analgesic agent. The total amount of tramadol was 218±57.1 mg in Group LA, while it was 152±59.4 mg in Group FNB (p=0.01) (Table 2). There was no statistically significant difference between the study groups in preoperative, perioperative and postoperative MAP and HR (p>0.05) (Table 4). Mild nausea was observed in only one patient in both groups, according to the nausea-vomiting score (p>0.05) (Table 5). In the FNB group, both patient and surgeon satisfaction were significantly higher than in the LA group (p<0.001) (Table 5).

Discussion

EVLA is a minimally invasive procedure and is a safe and effective way to eliminate reflux in chronic venous insufficiency with less morbidity, faster recovery, and better cosmetic outcomes [10]. This procedure is typically performed on a outpatient basis and patients can be discharged home a several hours after the procedure. For this reason, the preferred anesthesia method is very important to minimize the pain that will occur during the procedure. Complications of surgical varicose treatment, such as infection and nerve damage, are common. Different anesthesia methods are used during EVLA applications. Patients who underwent general anesthesia may be discharged later due to complaints such as nausea-vomiting, postoperative pain and sore throat due to general anesthesia. General anesthesia and post-operative pain lead to longer hospital stay and post-procedural recovery [6,8]. Therefore, peripheral nerve blocks have become common in outpatient procedures such as EVLA [5-8,11]. In this study, we aimed to retrospectively analyze the findings of patients who underwent EVLA procedure with femoral block or local anesthesia.

The femoral nerve is the widest branch of the lumbar plexus and is 2nd 3rd and 4th originates from the lumbar nerve. The femoral nerve passes through the psoas muscle and follows the lateral edge of the lower part of the psoas and runs downwards between the iliac fascia and the psoas muscle. The femoral nerve eventually bifurcates at the level of the inguinal ligament. The anterior branch of the femoral nerve provides motor innervation to the pectineus and sartorius muscles. In addition, middle cutaneous and medial cutaneous branches originating from the anterior branch provide anterior and medial sensory innervation of the leg. The posterior branch provides the sensory innervation of the most medial saphenous nerve and the medial thigh, and the motor innervation of the quadriceps muscle. The femoral nerve has articular branches that go to the knee and hip joint. FNB provides anesthesia of the muscles and skin on the anterior surface of the thigh, the majority of the femur and the knee joint, as well as the skin of the medial part of the leg under the knee joint. Therefore, when the anterior and posterior branches of the femoral nerve are blocked, anesthesia can be provided for the procedures to be performed in the varicose vein tracing by numbing the anterior and medial parts of the entire leg. Similar to the results of our study in the treatment of varicose veins with EVLA, there are publications reporting that FNB is sufficient [3,5,8].

We found few studies in the literature reporting the use of peripheral nerve blocks for analgesia during EVLA [5-8, 11]. In a prospective study by Dzieciuchowicz et al.,

including 50 patients, only TA was applied to 25 of 50 patients who underwent EVLA, while the other 25 patients were administered FNB with 20 ml of 1% lidocaine under USG guidance. Pain scores of both groups were compared. They found that the VAS scores of the patients who underwent FNB were statistically significantly lower. In addition, the amount of TA consumed in patients who underwent FNB was also significantly lower [7]. In our this study, It was found that the VAS scores of the FNB group and the amount of TA used were significantly lower ($p<0.001$).

Some studies have reported dissatisfaction with paresthesia after femoral block [12]. Ozturk et al. in their study; stated that they did not have paresthesia complaints and did not observe dissatisfaction in patients who underwent TA-guided EVLA after applying a femoral block, and that this was due to the initial sedation and local anesthetic included in the tumescence [8]. In our study, we did not encounter paresthesia after femoral block. We think that paresthesia is prevented by giving sedation to the patients before the procedure, using USG while applying the femoral block, enabling more effective differentiation of nerve tissue, and the effect of the local anesthetic agent in the tumescent solution.

EVLA may cause direct thermal injury to the vascular endothelium and lead to vessel stenosis. In order to protect the surrounding tissues from the heat of the laser energy in the vein wall, it is necessary to administer more than one injection to deliver TA around the GSV. These injections may cause patients to experience pain. Many anesthesia methods are used to reduce the pain caused by both the EVLA procedure and the TA. It has been reported that general anesthesia and neuraxial blocks cause delayed mobilization, longer hospitalizations, and increased costs in patients. Therefore, USG-guided peripheral block applications have become widespread in EVLA applications [7,10].

When the anterior and posterior branches of the femoral nerve, which is the largest branch of the lumbar plexus, are blocked, loss of sensation occurs in the anterior and medial parts of the entire leg. There are studies reporting that the necessary analgesia for EVLA application is provided with the loss of sensation created in this trace after the application of the femoral block [2-6, 8]. In our study, we observed that the patients who underwent femoral block had lower VAS scores in EVLA procedures than the patients who underwent EVLA procedure only by applying local anesthesia.

In USG, the femoral nerve is clearly observed at the level of the inguinal ligament, lateral to the common femoral artery. It has been reported that the use of USG during femoral block decreases the risk of femoral artery puncture [6, 7, 13]. In addition, there are studies reporting that complications such as unsuccessful block, infection, and hematoma risk are reduced in peripheral blocks performed under USG [8, 13]. Similarly, in our study, we did not encounter any arterial puncture in any of the cases in which we performed FNB under USG.

The peripheral nerve blocks, as with whichever procedure, have known complications, and many factors contribute to that. Unsuccessful block applications may be due to the experience of the practitioner and the physical condition of the patient such as obesity. Hematoma or infection development may be due to multiple injection attempts or insertion of a catheter [6, 13]. In our study, we had one patient who was obese. However, the use of USG provided a clear field of view and the block was successful. In addition, we did not encounter hematoma or infection since we made a single shot in FNB applications and we did not use a catheter. However, we could not evaluate long-term complications since EVLA procedures are outpatients.

In the EVLA technique, which is used in the treatment of varicose veins due to chronic venous insufficiency, the risk of deep vein thrombosis decreases in cases with early mobilization with FNB performed to provide pain control. The epidural anesthesia, general anesthesia or conscious sedation applications, the risk of deep vein thrombosis increases due to delayed mobilization, and high treatment costs occur due to prolonged hospitalization [14-16]. Venous thrombosis was not found in any of the cases in our study, and they were discharged on the same day, but we could only evaluate complications on the day of the procedure, since there were no long-term control results in the files of the patients we examined retrospectively.

In the literature, we have found a limited number of studies in which clinicians who performed EVLA procedure after peripheral block under USG shared their experiences [5-8,12,14]. Therefore, based on the findings we found in our study, we aimed to contribute to the literature by declaring that the FNB application for the EVLA procedure reduces the risk of thromboembolic complications by allowing for early mobilization and pain in patients, and is a highly effective and reliable method that increases both patient and surgeon satisfaction.

Conclusion

As a result, we concluded that ultrasound-guided FNB applications in EVLA procedures are an effective, technically easy and safe method that reduces the need for additional analgesics, pain associated with tumescent anesthesia and endoluminal laser ablation of the great saphenous vein, and increases patient and surgeon satisfaction.

Disclosure

This work was partly presented in the congress of 17 th Ulusal Rejyonal Anestezi dated May 19-21, 2021.

Conflict of interest

No conflict of interest was declared by the authors.

Financial disclosure

The authors declared that this study has received no financial support.

Ethics approval

Ethical approval was obtained from the Elazig Fırat University Non-Interventional Research Ethics Committee for this study (Session number: 2022/ 08-19).

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