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Research Article

Comparison of tumescent versus ultrasound guided femoral and obturator nerve blocks for treatment of varicose veins by endovenous laser ablation

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KEYWORDS
Tumescent anesthesia;
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Ultrasound

Abstract *Background:* Endovenous laser ablation (EVLA) is a new method for treating greater saphenous vein insufficiency. Most of physicians use local anesthesia for needle punctures and tumescent anesthesia (TA) to prevent pain and protects the surrounding tissues from the conduction of heat that would originate from the effects of laser energy on the venous wall. The aim of this study is to compare the use of local tumescent anesthesia alone or combined with ultrasound guided femoral and obturator nerve blocks for treatment of varicose veins by endovenous laser ablation.

Methodology: This is a randomized, double blind study included 80 patients scheduled for endovenous laser ablation for varicose veins of the great saphenous vein (GSV) located in the anterior or medial aspect of the leg were prospectively divided into two groups of 40 patients each. Group (A) had EVLA using tumescent anesthesia given by the surgeon. Group (B) had femoral and obturator nerves block before tumescent anesthesia was done. Intraoperative pain associated with applying the tumescent anesthesia and during performing ablation was measured using visual analogue scale. Volume of tumescent was compared in both groups. After finishing the operation, femoral and obturator motor block were evaluated. Postoperative VAS, time of stay in recovery area, patient and doctor satisfaction were also measured.

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Results: Pain on application of tumescent anesthesia and during surgery revealed that group (A) had more intense pain than group (B). Volume of tumescent used during surgery; group (B) used statistically significant less tumescent solution than group (A). Motor block was measured after finishing the operation, 100% of group (A) had no restriction to active movements while 2.5%, 80% and 7.5% had no restriction, mild restriction and moderate restriction to active movements, respectively in group (B). Group (A) had more pain than group (B) postoperatively. Duration of post procedure stay in recovery area showed no statistically significant difference between the two studied groups. Patients and doctors satisfaction was significantly higher in group (B) in comparison to group (A).
Conclusion: Ultrasound guided femoral and obturator nerve blocks combined with tumescent anesthesia are effective methods of anesthesia during endovenous laser ablation than using tumescent anesthesia alone.

1. Introduction

Surgery was considered the only choice for treatment of varicose veins. However, complications such as infection and nerve damage were not uncommon. Also general anesthesia, postoperative pain leads to increase in hospital stay. Minimally invasive procedures using (endovenous laser ablation [EVLA] or radiofrequency ablation [RFA]) are safe and effective ways of eliminating reflux with less morbidity, faster recovery, and improved cosmetic results [1]. This procedure is typically performed in the outpatient setting, and patient was discharged home several hours after the procedure is complete.

EVLA is a new method for treating greater saphenous vein insufficiency. This method causes direct thermal injury to endothelium and results in vessel occlusion [2]. Most of physicians use local anesthesia for needle punctures and tumescent anesthesia (TA) to prevent pain and protects the surrounding tissues from the conduction of heat that would originate from the effects of laser energy on the venous wall [3]. However, multiple needle punctures and, particularly, injection of the local anesthetic (LA) solution along the veins, such as great saphenous vein (GSV), may produce considerable pain during TA. A number of centers use epidural and general anesthesia [2]. Although the patient has no pain with these methods, they are generally not recommended because delayed mobilization may increase the risk of deep venous thrombosis as well the cost is increased because the procedure requires a dedicated staff and hospital stay [4].

Intravenous conscious sedation using fentanyl and midazolam can be given. Narcotic analgesics are more effective, but may cause respiratory depression; decreased consciousness and these may interfere with the mobility of the patient after the procedure [5].

Sensory innervation areas of the femoral nerve that supplies the muscles and skin of the anterior thigh and obturator nerve that supplies the skin on the medial aspect of the thigh proximal to the knee favor the use of ultrasound in their block for interventions in the great saphenous vein [6].

The aim of this study is to compare the use of local tumescent anesthesia alone or combined with ultrasound guided femoral and obturator nerve blocks for treatment of varicose veins by endovenous laser ablation.

2. Patients and methods

The study was conducted in Ain Shams University hospitals at the vascular surgery department. After obtaining approval from the hospital ethical committee and written informed consent from patients, 80 patients of ASA physical status I and II, of both sexes, age ranging between 30 and 60 years, and scheduled for endovenous laser ablation for varicose veins of the great saphenous vein (GSV), perforating vein (PV), or a combination of them located in the anterior or medial aspect of the leg was prospectively enrolled in this study. Exclusion criteria include patients who refused regional anesthesia, those with coagulopathy, impaired consciousness, and mental retardation. It was estimated that a sample of 40 patients per group would have a power of 80% to detect a standardized difference of 0.65 between the two study groups as regards the tumescent volume and pain scores using a two-sided Mann–Whitney U test and setting the type I error at 0.05.

Preoperative investigations in the form of ECG, chest X-ray, complete blood picture and coagulation profile. Details of anesthesia technique and study protocol were explained to the patients at the preoperative visit. I.V. line was inserted, all patients received midazolam 1–2 mg, basic monitors were applied (ECG, pulse oximeter, NIBP). Then patients were divided randomly into two groups:

2.1. Group (A)

40 Patients had EVLA using tumescent anesthesia given by the surgeon. (Lidocaine (400 mg/l = 0.04%), epinephrine (1 mg/l = 1:1,000,000) and sodium bicarbonate (10 mEq/l) in a physiologic saline solution pushed by a power pump. The patient was placed supine on the table in the reverse Trendelenburg position to distend the veins. After intradermal injection of a small amount of local anesthetic, the incompetent vein was punctured with an 18-gauge needle under US guidance. An angled tip 0.035-in. guide wire was then advanced and passed through the junction of the incompetent vein with the deep veins. The laser catheter (or sheath) was advanced over the guide wire and placed near to the junction. The guide wire was then removed and the tumescent solution was injected around the vein under US guidance. After TA, the laser fiber was inserted into the catheter and its tip was positioned several centimeters below the junction.

2.2. Group (B)

40 Patients had femoral and obturator nerves block before tumescent anesthesia was done. Patient position was supine with leg slightly abducted and externally rotated. The trans-

ducer should be placed in the infrainguinal region with the goal of imaging the femoral artery in its true short axis. Once the artery had been located, the femoral nerve can be identified as an oval hyperechoic structure lying just lateral to the artery. The needle was inserted at a roughly 45-degree angle using the In-plane technique. 50 mg Lidocaine in 20 ml saline was injected and a characteristic spread of the local anesthetic confirmed the correct needle tip location.

As regards the obturator nerve, locate the femoral vessels the slide the probe medially over the adductor compartment. Identify the useful landmark of the "Y" shaped fascial convergence: adductor brevis is media; adductor longus on the top of the forks of the "Y"; pectineus is lateral. The obturator nerve anterior division travels down the adductor compartment from lateral to medial (initially at the foot of the "Y" between pectineus and brevis; more distally at the junction of the 3 forks of the "Y" and distal still between adductor longus and brevis). The posterior division lies between adductor brevis and magnus. The target injection points are between the respective muscles. By using In-plane technique, 20 mg lidocaine in 10 ml was injected by the needle to each of the target fascial layers.

To follow the double blind nature of the study, the anesthesiologist who attended the surgery and recorded the data was blind to both groups assigned.

Intraoperative pain associated with applying the tumescent anesthesia and during performing ablation was measured using visual analogue scale (VAS) (0–10). Whenever patient complained of pain during the surgery, the surgeon used an additional dose of local anesthetic. Volume of tumescent was compared in both groups.

After finishing the operation, patient was put on compression stockings and examined for the presence of motor block. The patient was asked to flex his/her hip and keep the knee in full extension, to evaluate the strength of the quadriceps femoris muscles. Femoral and obturator motor block was defined as severe (3—unable to extend the knee, adduct the thigh), moderate (2—unable to keep the knee extended and thigh adducted against gravity), or mild (1—unable to keep the knee extended and thigh adducted against manual resistance), (0—no restriction of active movement range) of motion.

Postoperative VAS (if VAS > 4 NSAID was given), duration of post procedure stay in recovery area, patient satisfaction was done by asking the patient to answer the question, 'How would you rate your experience during surgery?' using a 7-point Likert verbal rating scale. Surgeons were also asked to rate their satisfaction with operative conditions, using the 7-point Likert verbal rating scale at the end of surgery, acceptable satisfaction score of both the patient and surgeon being 5–7.

3. Statistical methods

The required sample size was calculated using the G*Power© software version 3.1.0 (Institut für Experimentelle Psychologie, Heinrich Heine Universität, Düsseldorf, Germany).

Data were analyzed on a personal computer using the IBM© SPSS© Statistics version 21 (IBM© Corp., Armonk, NY, USA). The Shapiro–Wilk test was used to test the normality of numerical data distribution. Normally distributed data were presented as mean (SD) and the unpaired t test was used for intergroup comparisons. Skewed data were presented as median (interquartile range) and the Mann–Whitney U test was used to compare between-group differences. Categorical data were presented as ratio or as number (percentage) and differences between the two groups were compared using the chi square test or linear-by-linear association for nominal or ordinal data, respectively.

$P < 0.05$ is considered statistically significant.

4. Results

There were no significant differences between groups with respect to age and gender (Table 1). No patient was excluded after inclusion to study. All patients were able to complete the entire study and their data were included in the final analysis.

Pain on application of tumescent anesthesia and during surgery was measured using visual analogue scale (VAS). It revealed statistically significant difference between the two studied groups, where group (A) had more intense pain than group (B). ($P < 0.01$.) Table 2.

As regards volume of tumescent used during surgery, group (B) used statistically significant less tumescent solution (428.7 ± 56.4) ml than group (A) 284.5 ± (26.6) ml. ($P < 0.01$.) Table 2.

Motor block was measured after finishing the operation, it showed that there was statistically significant difference between the two studied groups, 100% of group (A) had no restriction to active movements while 2.5%, 80% and 7.5% had no restriction, mild restriction and moderate restriction to active movements, respectively in group (B). ($P < 0.01$.) Table 2. No one had severe restriction of active movement in both groups. All patients who developed mild or moderate motor block were able to walk, although company with another person was preferred.

There was statistically significant difference as regards to postoperative VAS ($P < 0.01$). Group (A) had more pain than group (B). Table 3.

Scores used in the study

Visual analogue scale VAS (0–10 cm)

0	2	4	6	8	10
No pain					Worst pain

Likert scale

1	2	3	4	5	6	7
Extremely dissatisfied	Dissatisfied	Somewhat dissatisfied	Undecided	Somewhat satisfied	Satisfied	Extremely satisfied

Table 1 Patient characteristics.

Variable	Group A (n = 40)	Group B (n = 40)	P value
Gender (male/female)	22/18	21/19	0.823
Age (year)	43.3 ± (8.0)	44.5 ± (7.8)	0.500

Data are presented as ratio or as mean (SD).

Table 2 Operative data.

Variable	Group A (n = 40)	Group B (n = 40)	P value
Pain score on injection of tumescent solution	5 (4–6)	1 (1–2)	< 0.001
Average pain score during surgery	3 (2–4)	1 (0–1)	< 0.001
Volume of tumescent solution (ml)	428.7 ± (56.4)	284.5 ± (26.6)	< 0.001
Motor blockade			< 0.001
No restriction of active movement	40 (100%)	1 (2.5%)	
Mild restriction of active movement	0	32 (80%)	
Moderate restriction of active movement	0	7 (17.5%)	
Severe restriction of active movement	0	0 (0%)	

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

Table 3 Postoperative data.

Variable	Group A (n = 40)	Group B (n = 40)	P value
Time spent in recovery area (min)	18.2 ± (2.9)	17.9 ± (2.5)	0.656
Postoperative pain score	3 (3–4)	0 (0–1)	< 0.001
Patient satisfaction score	5 (4–5)	6 (5.5–6)	< 0.001
Surgeon satisfaction score	5 (4–6)	7 (6–7)	< 0.001

Data are presented as mean (SD) or median (interquartile range).

Duration of post procedure stay in recovery area showed no statistically significant difference between the two studied groups. ($P > 0.05$.) Table 3. All patients were discharged after a routine 20–25 min walking under observation and instructed to be active (walking or performing foot exercises) for at least 4 h while at home.

Patient's satisfaction was significantly higher in group (B) in comparison with group (A) ($P < 0.01$). The same as regard doctors satisfaction where group (B) was significantly higher than group (A). ($P > 0.01$.) Table 3.

5. Discussion

In this study, pain during injection and application of tumescent anesthesia was studied in patients who took only tumescent anesthesia (group A) versus patients who had taken ultrasound guided femoral and obturator nerves block (group B). VAS was lower in group (B) than in group (A). Tumescent anesthesia is achieved by injecting a very dilute solution of local anesthetic combined with epinephrine and sodium bicarbonate into tissue until it becomes firm and tense (tumescent). For one leg, 250–500 ml of solution is usually sufficient [7]. Group (B) used significantly less amount of tumescent solution than group (A). Although no toxicity of local anesthetic had occurred through all the study groups, group (B) had less chance of local anesthetic toxicity due to the lower dose of tumescent solution used.

Deep venous thrombosis incidence was high after the procedure. So patients were preferred to walk shortly after the operation and keep active for some hours thereafter [8]. To achieve this, nerve blocks needed to provide analgesia with minimal or no motor block. By using lidocaine 50 mg diluted in 20 ml saline, good analgesia without significant block was achieved in 80% in group (B). Early mobility of patients leads to the insignificance between both groups as regards the PACU stay.

VAS postoperatively was significantly lower in group (B) than group (A). This result helped the patients to move and decrease their stay in the recovery area.

Also patients in group (B) were more satisfied than patients in group (A) at the end of the study. Surgeons noticed slight increase in the diameter of the refluxing veins after the nerve blocks due to the sympathetic blockade. This venous distension made the puncture and catheterization easier, with the absence of venous spasm, facilitated the EVLA procedure. Also nerve block gave chance for the surgeon for several trials to puncture the vein if failed from the first time without harming the patient. So doctors in group (B) were more satisfied significantly than group (A).

The femoral nerve is the largest branch of the lumbar plexus. It passes under the inguinal ligament, and then it divides into two branches. The anterior branch supplies motor innervations to the sartorius and pectineus muscles and sensory innervations to the skin of the anterior and medial thigh. The posterior branch supplies motor innervations to the quadriceps muscle and sensory innervations to the medial aspect of the lower leg via the saphenous nerve. Medial aspect of the thigh proximal to the knee joint is supplied by obturator nerve. Thus, when both these nerves blocked at the level of the inguinal ligament, sufficient analgesia (or anesthesia) is provided to the anterior and medial aspects of the thigh and leg, where an incompetent GSV and the resultant varicose veins are typically located [9]. Other studies had done similar researches but they had done femoral block only which did not cover all the medial aspect of the thigh [2,5].

Femoral and obturator ultrasound guided blocks did not require any additional cost to the procedure, and all the medications as well as ultrasound were available already during EVLA.

6. Conclusion

Ultrasound guided femoral and obturator nerve blocks combined with tumescent anesthesia are effective methods of anesthesia during endovenous laser ablation than using tumescent anesthesia alone.

Conflict of interest

There was no conflict of interest in this study.

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