European Review for Medical and Pharmacological Sciences 2014; 18: 3459-3463

Selective retention of the great saphenous vein to prevent saphenous nerve injury during varicose vein surgery

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Abstract. – OBJECTIVE: To explore the selective retention of the great saphenous vein trunk below the knee to prevent saphenous nerve injury during varicose vein surgery.

PATIENTS AND METHODS: This research was a single-center prospective randomized trial. From January 2009 to January 2012, 280 patients of varicose veins in the great saphenous vein were treated and divided into two groups of 140 cases each. In the observation group, the vascular trunk of the great saphenous vein was stripped to below the knee level whilst that in the control group, it was stripped to the ankle level. Patients in both groups were treated with a transilluminated powered phlebectomy (TIPP) and foam sclerotherapy. Primary end points were postoperative pain, saphenous nerve injury, quality of life and recurrence rate.

RESULTS: After one month follow-up: 5.71% of patients in the observation group had neurological symptoms, while 14.29% of patients had neurological symptoms in the control group. The saphenous nerve injury between the two groups was statistically significant. Postoperative follow-up of one year, 1.47% patients had symptoms of neurological disorders in the observation group, while 7.14% patients had symptoms of neurological disorders in the control group. The saphenous nerve injury between the two groups was statistically significant. Therefore, selective retention of great saphenous vein below-knee can prevent saphenous nerve injury. The main outcome measures were postoperative pain, missing saphenous nerve, improvement of symptoms and the incidence of recurrence.

The follow-up after one month showed that the percentage of neurological symptoms in the observation group and the control group was 5.71% and 14.29% respectively, and the saphenous nerve injury showed a statistical difference. The follow-up after one year showed 1.47% of abnormal sensation in the observation group and 7.14% of dysesthesia or paresthesia in the control group in surgical limb according to subjects' claims, and there existed a statistical difference in the saphenous nerve injury.

CONCLUSIONS: The selective retention of the great saphenous vein trunk below the knee can prevent the saphenous nerve injury.

Key Words:
Varicose veins, Randomized controlled trials, Saphenous nerve injury, Surgery.

Introduction

High ligation and stripping of the great saphenous vein (GSV) surgery is the surgical procedure for treatment of varicose vein of the lower limb. Its long-term effectiveness has been proven. Despite the lower relapse rate, the entire saphenous vein stripping would result in higher occurrence of postoperative saphenous nerve injury. This study compared the selective retention of the trunk of the great saphenous vein below the knee with the entire stripping of the great saphenous vein, and evaluated the effects of the two methods on the postoperative recurrence rate and saphenous nerve injury.

Materials and Methods

Design of the Research

A total of 280 patients diagnosed with varicose veins with great saphenous vein reflux were treated in our department from January 2009 to January 2012. They were divided into two groups of 140 cases each by coin tossing. The vascular trunk of the great saphenous vein in the observation group was stripped to below the knee level whilst that in control group, the vein was stripped to the ankle level. Patients in both groups were treated with a transilluminated powered phlebectomy (TIPP) and foam sclerotherapy.

Inclusion criteria for subjects: (1) A reflux of great saphenous vein above or below the knee

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confirmed by color Doppler ultrasonography. (2) The varicose veins were graded to C2-5EpAsPr by f Clinical-etiology-anatomic-pathophysiologic classification system (CEAP).

Exclusion criteria for subjects: (1) Varicose veins caused by vein thrombosis, Budd-Chiari syndrome and other diseases were determined by preoperative color Doppler ultrasonography and/or venography, or a medical history of deep venous thrombosis in lower limbs recorded; (2) A history of lower extremity surgery; (3) Diabetic foot; (4) Superficial thrombophlebitis; (5) Injury of intervertebral discs; (6) Occlusive disease in peripheral arteries; (7) C6 active stage of venous ulcers.

General Data

The 280 patients were randomly divided into two groups of 140 cases each. Amongst the cases in the observation group, 64 are male and 76 female, aged from 37 to 76 years with an average of 46 ± 9 years, and having a disease course of 2-20 years at an average of 8.6 ± 2.2 years. And 86 and 54 cases suffered from the left or right lower limb lesions, respectively, whose grades of varicose veins were C2 in 28 cases, C3 in 25 cases, C4 in 74 cases and C5 in 13 cases. Ultrasonic diagnosis confirmed that 108 patients had reflux of the great saphenous vein below the knee. In the control group, there were 60 males and 80 female patients, aged from 35 to 74 years with an average of 45 ± 9 years, with a course of the disease 2-25 years at an average of 9.2 ± 3 years. Amongst the patients, 84 cases suffered from left lower limb lesions, whilst 56 cases from right lower limb lesions. Their grades of the varicose veins were C2 in 24 cases, C3 in 26 cases, C4 in 74 cases and C5 in 16 cases. Ultrasonic diagnosis confirmed 102 cases of the reflux of great saphenous vein below the knee. All cases of both groups were marked in the reflux site of the vein before surgery. There were no statistical differences for patients in terms of gender, age, disease course, CEAP classification, the proportion of the reflux of great saphenous vein below the knee between two groups.

Methods

All patients with varicose veins were classified following the CEAP system. Saphenous nerve injury was determined by using sensory testing together with a standardized questionnaire. To eliminate the differences among the observed patients, both preoperative and postoperative sensory testing was performed in patients to identify potential sensory nerve defects. Paresthesia was defined as "a spontaneous abnormal sensation in the absence of external stimuli", described as "numbness" or "prickling sensation". Dysesthesia is defined as "an unpleasant sensation different from the actual feeling". If patients have different postoperative sensation compared with preoperative feelings, such as pain in the legs, discomfort and numbness, or any areas of the newly discovered insensible feelings and hypesthesia, all the postoperative sensational changes and new areas of abnormal feelings are recorded to draw attention in the follow-up examination to these new areas. Sensation tests included light touch test (with cotton) and pain tests (using a special needle in neurology), requiring patients to close their eyes and answer questions during the check, and the entire innervation area of saphenous nerve must be checked. When an anesthesia is located, the examination is performed from abnormal to normal region to locate the entire abnormal region. When the dysesthesia is located the examination is performed from normal to abnormal region to determine the boundaries.

In the observation group, a 2 cm incision was made in groin area where the high ligation was practiced in GSV and its branches and the stripper was inserted in a retrograde direction. In the cases without reflux of the great saphenous vein below the knee, the inserted stripper was pulled out from the vein incision in the upper part of the shank.The stripping was performed through the varus along the proximal trunk, vascular bed flushed with anesthesia tumescent fluid followed by hemostasis compression. Based on the preoperative ultrasound examination results, the treatments of the great saphenous vein in distal end were as follows. The cases with the reflux of the great saphenous vein below the knee were treated with foam injection sclerotherapy followed by ligation. In the cases without reflux of the great saphenous vein below the knee, the trunk of the great saphenous vein below the knee was reserved via ligation exclusion, but its branches were treated through foam sclerotherapy followed by ligation. The traffic branches marked with preoperative reflux were incised and then ligated. The traffic branches linking the great to the small saphenous veins were carefully distinguished and ligated. The collective of varicose veins were excised by Trivex translucent potary, while the scattered varicose veins or those in dorsum of the foot were treated with foam scle-

rotherapy. In the control group, the GSV trunk was stripped till the level above medial malleolus and all the other treatments were the same as in the observation group.

After the surgery, an elastic bandage was used to compress the affected limb. Patient ambulated two hours after surgery and wore elastic compression stockings 24 hours after surgery (ankle pressure of 25-30 mmHg, 1 mmHg = 0.133 kPa). Then the patient was asked to wear elastic stockings 24 hours a day during the first week after surgery, and wear them only during the day in the following two weeks.

The follow-up was made twice, one month and one year after surgery. The recovery relapse and nerve injury were observed and recorded. The first follow-up reached a success rate of 100% in both groups and there were no perioperative deaths. In the second follow-up, 136 cases in the observation group and 126 cases in the control group were visited, reaching a follow-up percentage of 97.14% and 90% respectively.

Statistical Analysis

The data were analyzed with SPSS 13.0 (SPSS Inc., Chicago, IL, USA) and statistically treated by using *t*-test. All enumeration data were compared using the chi-square test. The significant level of $p < 0.05$ was considered as statistical difference.

Results

The basic data in terms of gender, age, medical history, CEAP classification and reflux of great saphenous vein below the knee showed no statistical differences between the two groups of patients.

In observation group 10.71% (15/140) of cases complained of limb pain after surgery, 5.71% (8/140) showed neurological symptoms, 4.28% (6/140) showed symptoms of dysesthesia in the lower limb, 1.43% (2/140) showed symptoms of paresthesia in the lower limb. Neurogenic examination based on physical diagnosis determined eight cases with saphenous nerve missing in lower limb (5.71%). Amongst the eight cases diagnosed by light touch test with cotton and the pain test with neurological needle there were six limbs (4.28%) with paresthesia and two limbs (1.43%) with paresthesia.

In the control group 12.86% (18/140) of the cases complained of pain in limb after surgery, 14.29% (20/140) showed neurological symptoms, 8.57% (12/140) showed dysesthesia in lower limb, 5.71% (8/140) showed symptoms of paresthesia in the lower limb. Neurogenic examination determined 20 cases with saphenous nerve missing in the lower limb (14.29%), and amongst the 20 cases diagnosed by light touch test with cotton and the pain test with neurological needle there were 12 limbs (8.57%) with paresthesia and 8 limbs (5.71%) with paresthesia.

Table I also showed the follow-up results 1 year after operation in detail.

In the observation group, no patients complained of pain in the affected limbs after surgery. Ninety seven percent of the patients (132/136) showed postoperative improvements the recurrence rate was 2.2%, in three cases. A few cases 1.47% (2/136) complained of paresthesia in the affected limb after surgery. Neurogenic examination discovered the saphenous nerve missing in the affected limbs of the two cases who also received the light touch test with cotton and the pain test with the neurological needle. As showed by the follow-up one year after the surgery, blood flowed smoothly in the middle and lower section of the great saphenous vein in shank of 32 patients whose trunks of the great saphenous vein in shank were in exclusion. This was proved by ultrasound examination.

In the control group, no patients complained of pain in the affected limbs after surgery. The

Table I. The results of postoperative follow-ups.

Groups	One month after operation		One year after operation		
	Pain in affected limbs	Absence of saphenous nerve	Absence of saphenous nerve	Recover from symptoms	Relapse
Observation	15/140	8/140	2/136	132/136	3/136
Control	118/140	20/140	9/126	125/126	2/126
Chi-square value	0.31	5.71	5.23	0.67	0.00
p	0.58	0.02	0.02	0.41	1.00

recurrence rate was 1.6% in two cases. Patients of 98% (125/126) showed postoperative improvements of symptoms and signs. Some cases 7.14% (9/126) complained of dysesthesia or paresthesia in affected limb after operation. Neurogenic examination based on physics discovered the saphenous nerve missing in the affected limbs of the nine cases who also received a light touch test with cotton and the pain test with neurological needle. Amongst them there were six case of dysesthesia (4.76%) and three cases of paresthesia (2.38%) in the limbs.

Discussion

Anatomical study[1] showed that the saphenous nerve and the great saphenous vein in the middle and lower segments of the shank showed complex spatial relationships because of the anatomic adjacency. The possible forceps clip, drag and extension or suture of the concomitant nerve fibers during the stripping of the great saphenous vein may injure the saphenous nerve. The surgeons even with a good knowledge of anatomy cannot avoid injury to the saphenous nerve during surgery. As reported in the literature, the complication rate of injury to the saphenous nerve in the therapeutic stripping of the great saphenous vein can be as high as 6 % to 53%[2-3]. Therefore, it has become an issue of concern to reduce the saphenous nerve injury during the surgical stripping. Cox et al[4] compared the impact of downward and upward surgical stripping of the entire saphenous vein on saphenous nerve and believed that the upward stripping caused a higher incidence rate of the saphenous nerve injury than the downward stripping. So the results of the downward stripping reported by Cox have been assessed in many other studies[5]. Zhang Yulin et al[6] believed that a significantly lower volume of the great saphenous vein tissue stuck to the stripping device during the stripping from ankle to groin in comparison with the stripping from the groin to the ankle. Less vein tissue stuck to the stripper will reduce the chances of contact with the saphenous nerve at inner ankle level and avoid damage to the saphenous nerve to some extent. But other studies [7] showed no differences in the nerve injury on chances between anterograde and retrograde strippings in saphenous vein. While the varus stripping method (invaginated stripping) may reduce trauma and avoid saphenous nerve injury, its success rate is not high in practice because of easy breakage of GSV during the stripping. Qin Jing et al[8] using the modified varus stripping method to prevent the saphenous nerve injury and achieved better results. As performed in recent years, the radio frequency and the cavity closure therapy with laser avoided the saphenous vein stripping and thus can reduce mechanical nerve damage. But such therapies cause damage to the saphenous nerve because the nerve becomes closer to the great saphenous vein along the downward path until to medial malleolus and laser or radiofrequency therapy can produce heat damaging the endothelial cell with up to12.3%[9] resulting in complications. Although, with minimally invasive surgical techniques there are much less nerve injuries caused by improper surgery. However, the problem of saphenous nerve injury in the whole treatment procedures in GSV remains unsolved.

Some scholars point out that a reservation of the great saphenous vein trunk below the knee could reduce injury to the saphenous nerve, but opponents argue that for patients with the reflux of great saphenous vein below the knee, the saphenous nerve injury often relapses. We retained the trunk of the great saphenous vein below the knee according to the preoperative ultrasonic diagnosis, and treated the patients with foam sclerotherapy. This method can avoid injury to the saphenous caused by dissection of the trunk of the great saphenous vein below the knee and by the thermal conduction during radiofrequency with endovenous laser. The foam hardener can increase the contact area with the vascular wall. The foam hardener can reduce the trauma caused by conventional surgical stripping in the vascular walls. Foam sclerotherapy can result in e complications such as pulmonary embolism. However, we treated the varicose veins after the removal of the trunk of the great saphenous vein. In addition, segments of the veins with reflux were incised followed by ligation, resulting in no serious complications. The incidence of vascular diseases is on the increase. The saphenous vein can be commonly used as grafts for coronary artery and artery bypass. Some patients had no reflux in saphenous vein below the knee according to ultrasonography before surgery, so it was unnecessary to strip the entire saphenous vein.

The treatment guidelines for varicose veins and chronic venous disease[10] clearly indicate the treatment for the great saphenous vein insufficiency and recommended high ligation and varus strip-

ping of the saphenous vein over the knee (Grade 2B). Our report shows that the selective retention of the great saphenous vein trunk below the knee in the stripping surgery ensured the efficacy and retained the vein for some patients, without increasing the risk of recurrence whilst effectively reducing the occurrence probability of the saphenous nerve injury. The relapse rates of the patients in this study showed no differences between the two groups one year after surgery. However, the observation period is not long enough and a long-term observation is required in further study.

Conclusions

According to ultrasound results, the selective retention of the saphenous vein trunk below the knee in surgery reduced the saphenous nerve damage due to anatomic positions, ensured the therapeutic efficacy, did not increase the relapse rate, and so can be used for effective prevention of the saphenous nerve injury.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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