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Review Article

Treatment of varicose veins of lower extremity: a literature review

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Abstract: Varicose veins of lower extremity are one of the most common diseases in peripheral vascular surgery. The clinical symptoms caused by simple lower limb veins are not obvious, but if patients do not take reasonable nursing measures, the disease will develop further, which not only affects their labor ability, but also reduces their quality of life, so we should prevent and treat varicose veins in time. It is a better choice for us to use a single or comprehensive treatment with the clinical manifestations of varicose veins of the lower extremity, so as to achieve the best therapeutic effect. In addition to lifestyle changes, primary treatment measures include surgical intervention (such as high ligation and stripping, valvuloplasty), minimally invasive therapy (such as sclerotherapy, intracavity laser therapy), compression therapy (such as medical elastic stocking therapy, elastic bandage therapy, intermittent pressure compression therapy). This paper summarizes the clinical research and the advantages and disadvantages of various treatment methods. It is shown that high ligation and stripping can be used as a radical treatment for patients in the late stage. It is necessary for patients with insufficiency of deep venous valves to adopt valvuloplasty, which will promote blood circulation in the leg. Laser therapy has gradually become the mainstream treatment for varicose veins of lower extremity due to its advantages of small trauma, no scars and low costs. Medical elastic stocking therapy, elastic bandage therapy and intermittent pressure compression therapy play important roles in postoperative care as well as in the treatment for the patient in the early stage. What's more, the intermittent pressure compression therapy can be used as a safe and simple therapy with no scars after treatment, which is promising treatment of varicose veins of lower extremity.

Keywords: Varicose vein, lower extremity, treatment, prevention

Introduction

Varicose veins of the lower extremity refers to abnormal leg condition, which is a disease of venous dilation and twisting of the lower extremities, mainly due to dysfunction of valves in great saphenous vein, small saphenous vein, perforator vein artery, and other subcutaneous veins in the leg, and occurs in people who are engaged in prolonged standing for long hours on the job, high physical activity intensity or long sedentary station; the incidence rate of this disease among adults is generally 20%-40% [1-4]. At present, the factors which contribute to such a defective state of the elastic tissue, with a resultant subluxation of the deep fascia of the leg in primary varicose veins, are still being investigated. Hereditary, dietetic, and endocrinal, as well as occupational, factors are being studied [5]. Hereditary factors include valve dysfunction and weakness of the vein wall, or the increase in superficial venous pressure due to manual labor, chronic cough, constipation, pregnancy, and the like. It is easier for women to be affected than men. The clinical manifestations of varicose veins are not obvious in the early stage of the disease. When the disease develops further, the venous dysfunction will continue to deteriorate, especially, varicose veins, which are a condition of the superficial veins of the leg, have become abnormally twisted, lengthened or dilated. Subjective symptoms include swelling, aching, itching and skin discoloration. What's more, many serious complications include thrombophlebitis, dermatitis, hemorrhage and ulcers. Such varicose

veins will cause impairment in quality of life of patients [6-10]. Therefore, it is necessary to attach importance to the venous diseases of lower extremity and to prevent and treat them in time.

At present, pressure therapy can be used to treat the primary varicose veins of lower extremity, including medical elastic stocking therapy, elastic bandage therapy and intermittent pressure compression therapy, which can temporarily relieve pain by external pressure. However, in the long term, the treatment method for patients with varicose veins of lower extremity is not very effective. Surgical intervention as the main way of radical resection of varicose veins of lower extremity, and commonly includes high ligation and stripping and valvuloplasty [11]. However, it is not a better choice for those who have the slight varicose vein phenomenon, especially for the female who loves beauty, due to postoperative limb left scars. What's more, there are some other disadvantages including long operation time, high cost, more surgical incision, and the like. In recent 10 years, with the development of minimally invasive techniques, laser therapy and sclerotherapy as new treatment choices for patients have attracted increasing attention. Minimally invasive technology has become the current mainstream treatment for varicose veins of the lower extremity because of the lower recurrence rate and fewer complications [12, 13].

This paper describes the treatment methods for varicose veins of lower extremity, and expounds separately the advantages and disadvantages of various treatment methods and the corresponding clinical application.

Surgical intervention

Surgical treatment, as the main treatment method for patients with varicose veins of lower extremity, is also a radical treatment choice. The commonly used surgical treatment includes high ligation and stripping and valvuloplasty. Especially, high ligation and stripping is the most classic operation among surgical treatments, and all kinds of modified procedures are based on this procedure. As the therapy is effective, has lower recurrence rate, and so on, it has been commonly used as current surgical procedure in clinic. Valvuloplasty is needed to treat the patient with insufficiency of deep venous valve.

High ligation and stripping

When high ligation and stripping is carried out, general or spinal anesthesia is used. The patient is placed in a supine position; a 6 cm incision is made in the femoral skin crease with its lateral end over the femoral pulse. The saphenofemoral junction is exposed, and all of its tributaries are divided and ligated, the stripper is pulled downward gently inside the vein and all heads larger than the vein must be removed, then the upper end of the vein is ligated with a double ligature and the femoral incision is closed [14].

High ligation and stripping is a radical solution, which means once the vein is removed, the varicose state will not recur. Advantages of the operation are as follows: without surrounding fibrosis, without injury to the structures surrounding the vein, particularly the saphenous nerve and most of the complications of the vein stripping operation are avoided [14]. Although there is a high success rate, the treatment method still has a lot of disadvantages such as many incisions, large trauma, high cost, and the like. In addition, surgery causes a risk of general anesthesia and exists long recovery time. High ligation and stripping may also leave permanent scars that affect the appearance of the leg. In view of these notable disadvantages, surgical method will hardly be selected. What's more, following surgery treatment, patients will be advised to wear medical elastic compression stockings to increase the effective of surgery.

Valvuloplasty

Insufficiency of great saphenous vein valve is the most serious causes of reflux, which may cause a series of clinical symptoms and signs. Therefore, eliminating reflux is the key method to treat varicose veins of the lower extremity successfully. It is ineffective to select high ligation and stripping because of these disadvantages, such as high postoperative recurrence, most of the patients may suffer from pain, limited mobility. Valvuloplasty is commonly adopted in clinic. It uses suture to tie up the fold of the great saphenous vein, which makes the vein funnel-shaped, and has advantages of less incision, easy operation, and short recovery time [15]. However, it also remains some disadvantages such as hospitalization, complications and the like.

Minimally invasive therapy

Minimally invasive treatment is used for treating patients with varicose veins of lower extremity increasingly, and its advantages in high efficacy and safety, beauty and economy are gradually concerned. At present, sclerotherapy and intracavity laser therapy are mostly used in clinic.

Sclerotherapy

Sclerosing therapy is a treatment choice for patients with varicose veins of lower extremity; it uses the intravenous injection of chemical drugs to achieve the goal of inflammatory occlusion. It is more suitable to treat capillary dilation and traffic veins, the superficial varicose veins of traffic veins, small saphenous vein trunk and large saphenous vein trunk. Sclerosing foam is commonly used to treat varicose veins, which is a mixture of gas and liquid sclerosing solution [16, 17]. The sclerosing agent injected into the intravascular can promote thrombosis by damaging the vascular endothelial directly; then it produces aseptic inflammatory lesions to make the tissue fibrotic, so that the pathological blood vessels are permanently occluded, achieving ideal therapeutic effects. Foam sclerotherapy is a modification of conventional technique of sclerotherapy, where bubbles of sclerosant are produced using either air or carbon dioxide, and then they are injected into the affected vein under sonographic guidance [18]. It is generally recognized that the sclerosing effect depends on the concentration of the drug within the vein, and not the concentration in the syringe [19].

Compared with the disadvantages of surgical methods, such as large trauma, multiple incision, a certain amount of blood loss, long hospitalization time and high medical expenses, sclerotherapy has the advantages of simple operation, small trauma, no hospitalization, little pain and low cost [20]. Besides, the skin has no surgical scars, which can satisfy the patient's psychological need of the body esthetics. However, the affected limb needs to be injected repeatedly to alleviate the effect of the disease, which cannot fundamentally remove diseased blood vessels. What's more, there is a high recurrence rate and complications including phlebitis, tissue necrosis, ulcers, pigmentation, allergies and so on. Currently, it is hardly used simply to treat varicose veins, and usually used as an adjuvant therapy after venous ligation of vein trunk. The combination of the two can complement each other and is a better choice, which is a promising trend for the treatment of varicose veins.

Intracavity laser therapy

Intracavity laser therapy is the use of laser producing high-energy heat to damage the vein vessel wall, so that it can make the venous wall fibrosis repair, contraction and closure, at the same time, heat can cause blood hypercoagulable state, and the whole venous thrombosis results in closure of venous fibrosis eventually [21]. What's more, the endothelium of the great saphenous vein is destroyed by laser heating and closed by external pressure, so that the main trunk of the great saphenous vein is not stripped off and the injury is minimal. The treatment may serve a broader range of clinical need and become a promising therapy.

Endovenous thermal ablation therapy has almost replaced high ligation and stripping as the treatment choice for primary incompetence of saphenous veins, because it is effective, has fewer complications and short recovery time, causes minimal postoperative pain [21, 22]. Compared with sclerosing agent injection, intracavity laser therapy is a better choice for treating occlusion of large saphenous vein and has a lower recurrence rate. However, it is not an effective treatment method for patients with varicose veins of lower extremity, curved protrusion of venous group or distorted severe variceal veins, and the recurrence rate of laser therapy is still higher than surgical treatment [16]. Laser treatment can cause fiber burst or puncture blood vessels, therefore, postoperative complications may occur, such as subcutaneous congestion, large saphenous vein backbone, local sclerosis or lumps in the lower leg, skin burn, thrombotic phlebitis, and the like. The thermal effect caused by the laser is prone to injure the adjacent saphenous nerve and cause abnormal sensation in the corresponding distribution area. Therefore, reducing the laser output power and accelerating the fiber retreat speed may reduce the complications.

Compression therapy

As the patient's clinical manifestations are not obvious, in addition to the nursing measures, such as the appropriate rest, avoiding the long

station, elevating the affected limb and other basic principles, external pressure can be applied to treat the patient with primary varicose veins of lower extremity. What's more, to avoid lower limb edema and other problems after surgery, it is necessary for patients with varicose veins to carry out pressure nursing in order to prevent the occurrence of complications. Compression therapies as treatment choices for the patient, including medical elastic stocking therapy, elastic bandage therapy and intermittent pneumatic device therapy, are commonly used.

Medical elastic stocking therapy

Medical elastic stockings, which are also known as vein-driven socks, are medical products designed specially and irreplaceable methods for treating varicose veins of lower extremity and preventing complications. Medical elastic stocking is one of the most widely used methods among mechanical compression methods because of its advantages of convenience, ease of use and sustained therapeutic function; it is applied to prevent varicose veins of lower extremity, relieve swelling and discomfort of leg, and support treatment during recovery period after lower limb vein stripping operation [23, 24]. It is more suitable for patients with poor body condition, asymptomatic, inability to tolerate surgery, disease limitation, varicose veins in pregnancy, and so on.

By increasing the weaving density and strength of elastic material at ankle joint and calf, medical elastic stocking can achieve the designed pressure gradient, which means that the pressure decreases upward from the ankle gradually. Medical elastic stocking is a method for promoting venous blood flow back, preventing blood stasis of lower limb vein and making swelling of affected limb disappear through contracting the muscle of legs so as to pressurize the vascular cavity [25]. According to the magnitude of pressure, the medical elastic stocking can be divided into low-pressure preventive type (daily health care for high-risk group, postoperative care), first-level middle pressure treatment type (treatment and prevention for superficial varicose veins), second-level high pressure treatment type and third-level high pressure treatment type. Second-level or third-level high pressure treatment is commonly chosen. Meanwhile, the circumference of the ankle and the distal fibula of the calf should be measured firstly, and then proper elastic stockings are chosen according to the measurement results. If the measured result is between two models, try to select a smaller size.

Medical elastic stockings have many advantages in preventing deep vein thrombosis after operation of primary varicose veins of lower extremity, relieving edema symptom, improving comfort and shortening hospitalization time. However, there are also some disadvantages such as time-consumption, laboriousness and inconvenience to wear. Medical elastic stockings are unsuitable for elderly and obese patients. Some products also contain latex and some other allergic substances, therefore, it is likely to cause allergies. In the early postoperative period of varicose veins of lower extremity, patients usually have lower limb edema and medial leg wounds. When wearing elastic stockings, the patient needs to pull the elastic stockings to the sides, and sock body in calf area will be pulled repeatedly, so as to smooth twist and crease. Therefore, it is unavoidable to clamp the wound, which causes the pain of the wound. What's more, the uncomfortable warmth of a compression stocking is mentioned as the reason why this type of surgery is usually postponed to colder seasons [26]. As a result of gauze treatment for the wound after varicose vein surgery, wearing process is very easy to cause dressings off, which will result in wound exposure or even re-dressing, and bring inconvenience.

Elastic bandage therapy

Elastic bandage as a basic therapy for treatment and prevention of varicose veins of lower extremity, the effect of treatment is directly from the pressure on the limb to promote the venous blood circulation of the lower limb, so that it can relieve pain and swelling of the affected limb, and elastic bandage is mostly used as a liner due to its functions for keeping the dressing in place and preventing limb edema [24, 27]. Elastic bandage should be bandaged from far to near. In addition, the high pressure should be put on the far side, and the low pressure should be put on the near to promote the blood flow. Tightness of the bandage and the pressure are the key to the successful treatment, otherwise it is easy to produce post-

operative complications, leading to surgery failure. Compression therapy systems include single or multi-layer bandages, and the elastic bandage can be divided into short, medium, long-stretch. Besides, the choice of the elastic bandage should depend on various parameters, including convenience of use, and the patient's acceptability [28].

Compared with medical elastic stocking, elastic bandage has the disadvantage of inconvenient use, and it is not easy to control. Patients do not have a good grasp of the pressure of the elastic bandage, which means that wearing bandage is too loose to achieve therapeutic effect, but too tight may cause pain, limb swelling, insufficient blood supply, and even ischemic necrosis.

Intermittent pneumatic compression therapy

Intermittent pneumatic compression (briefly called IPC) is a sequential compression device from the foot, ankle and calf to thigh, including plantar venous pump, ankle-calf venous pump, calf venous pump and calf-thigh venous pump. The device meets the following conditions: sequential inflation, inflation pressure, time of inflation sufficient for translocation of tissue fluid to the proximal region, and no deflation of distal chambers [29]. In foreign countries, intermittent pressure device therapy began to appear in the 1960s, and it gradually became a medical technology in the 1970s.

IPC includes inflatable sleeves that are wrapped around the leg, the sleeves can be applied to the calf alone, or the calf and thigh. They are inflated at one side and compress the leg at intervals, some types inflate sequentially, which can stimulate blood circulation. The frequency of inflation can be fixed, or it can be varied in more sophisticated systems depending on the rate of the sleeves refilled [30]. IPC can make the patient's blood flow smoothly through the uniform massage with mechanical strength, and keep it consistent with the direction of human blood flow, so as to guarantee the increase of surface temperature, expand the limb micrangium and promote the circulation of blood. In the process of treatment, inflatable and deflated gasbags are equivalent to the contraction of blood vessels and vasodilation of blood vessels. Under the external force of uniform contraction and relaxation, it is effective to promote the blood flow of varicose veins and protuberant veins, relieve blood stasis and reduce vascular tension, which meet the needs of patients in treating and preventing varicose veins of lower extremity. As this treatment method with pneumatic massage, the massage technique is relatively soft. It has no side effects on the patient's skin because of the non-contact treatment, and will not cause allergic phenomenon after long-term contact. IPC is usually composed of two parts: gas path and circuit. Moreover, the gas path and circuit are separated, so there is no risk of electric shock injury, which ensures the absolute safety in the treatment process. Meanwhile, IPC is designed by the hydrologic parameters of edematous fluid, and can be used in a variety of compression bladders and models, such as sleeve location, inflation and compression cycle patterns. This therapy can be popularized in clinical practice because of its advantages such as non-invasive treatment, little pain, easy operation, and low cost, which greatly reduces the family pressure of patients [29, 31, 32]. Although the widely accepted use of IPC for the treatment of venous diseases, it is still unclear that how IPC exerts its beneficial effects [33].

Discussion

There are various treatment methods for patients with varicose veins of the lower extremity. High-risk groups should pay more attention to some changes of their lifestyle. Smoking and obesity are risky factors for varicose veins of the lower extremity. Daily exercise, including walking, ankle flexion and extension exercises, can improve the function of the gastrocnemius muscle pump, reduce lower extremity congestion and promote venous return. Moreover, patients should avoid sedentary station for a long time. Surgical therapy is a radical treatment choice for the patient with varicose veins of the lower extremity. High ligation and stripping is the mainstream choice among surgical treatment methods. The incisions should be treated with dressings after ligation and exfoliation, and it is necessary for patients to accept medical elastic stocking care; moreover, residual varices are managed by sclerotherapy [14, 34]. It is effective for patients with insufficiency of deep venous valve to adopt valvuloplasty. However, conventional surgery is usually performed in hospital and needs general or regional anesthesia, which may increase cost [35]. Besides, other disadvantages include long recovery time, many incisions, high cost, and

Table 1. Advantages and disadvantages of treatment methods for varicose veins of lower extremity

Therapies	Methods	Advantages	Disadvantages
Surgical therapy	High ligation and stripping	Radical cure, high success rate, low recurrence rate	High cost, large trauma, permanent scars, long recovery time
	Valvuloplasty	Less incision, easy operation, short recovery time	Hospitalization, exist complications
Minimally invasive therapy	Sclerotherapy	Small trauma, no hospitalization, little pain, low cost	High recurrence rate, exist complications
	Intracavity laser	No scars, no hospitalization, low cost, high success rate	Exist complications
Compression therapy	Medical elastic stocking	No scars, no hospitalization, use conveniently	High recurrence rate, cause allergies easily
	Elastic bandage	No scars, no hospitalization	Use inconveniently, high recurrence rate, cause allergies easily
	Intermittent pneumatic compression (IPC)	No side effects, low cost, no scars, no hospitalization, operate easily	High recurrence rate

scars in the postoperative leg. To a certain extent, the clinical application of traditional surgery is limited because of the above disadvantages. In recent years, minimally invasive technique as the treatment choice for patients with varicose veins of lower extremity has gradually become a promising treatment method. Local ablation therapy and endovascular treatment are increasingly used to treat patients with varicose veins of lower extremity, such as sclerotherapy, intracavity laser therapy and other treatments. Foam sclerotherapy is a safe and effective method for patients with varicose veins; moreover, it has no serious side effects. Foam sclerotherapy can be used to treat varicosities resulting from saphenous trunk reflux; foam has added the benefits of patient's satisfaction, short hospital stay and return to daily work early [17]. However, these methods still have certain complications and cannot completely replace traditional surgeries. It is particularly necessary to take postoperative nursing care to stabilize coagulation function, improve local blood circulation of the lower extremities and reduce intraoperative injury. Therefore, non-invasive mechanical prevention methods have gradually been paid more attention. Compression therapies are often used for patients to reduce postoperative edema, and different kinds of compression therapies on prevention of postoperative edema on donor legs are usually applied at four regions: foot (A area), heel (H area), ankle (B area) and calf (C area) [24]. Compression therapy, including medical elastic stockings, elastic bandages, IPC, is the treatment choice for postoperative care. There is no obvious difference in healing rates between stockings and bandages; but as stockings are less bulky, so it is more compatible with shoes [36]. However, when wearing medical elastic stockings, it is inevitable for the patients to pull elastic stockings, press the wound and cause pain in the wound, which suggests bandages may be more comfortable than stockings. Due to the special materials of elastic stockings and elastic bandages, they may cause allergies in the affected limb. Compared with foam sclerotherapy, IPC may decrease the risks of major bleeding complications [31]. What's more, IPC, which uses airbag compression to treat patients with varicose veins of lower extremity, can avoid above problems and has some other advantages such as high success rate, no trauma, no scars, lower recurrence rate and so on. IPC as a treatment choice for managing varicose veins appears to be safe without side effects.

In summary, this paper simply describes the advantages and disadvantages of various treatment methods for patients with varicose veins of lower extremity in **Table 1**. What's more, no treatment can completely replace another treatment, and it is meaningless to pursue minimally invasive therapy blindly. It is important to adopt appropriate treatment methods in the clinical treatment of varicose veins of lower extremity according to different CEAP grades [37]. For example, combination of multiple treatments for patients with severe varicose veins can achieve the best results, which is also a promising treatment choice for patients with varicose veins of lower extremity.

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Disclosure of conflict of interest

None.

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References

[1] Manfrini S, Gasbarro V, Danielsson D, Norgren L, Chandler JG, Lennox AF, Zarka ZA, Nicolaides AN. Endovenous management of saphenous vein reflux. J Vasc Surg 2000; 32: 330.

[2] Wang XP, Zhang Y, Su WJ, Wang SS, Wang Y. Oral administration and external application of chinese drugs combined with micro-invasive operation for the treatment of varicose ulcers in the lower extremities. Chin J Integr Med 2009; 15: 420-425.

[3] Satokawa H, Yokoyama H, Wakamasu H, Igarashi T. Comparison of endovenous laser treatment for varicose veins with high ligation using pulse mode and without high ligation using continuous mode and lower energy. Ann Vasc Dis 2010; 3: 46-51.

[4] Carroll C, Hummel S, Leaviss J, Ren S, Stevens JW, Everson-Hock E, Cantrell A, Stevenson M, Michaels J. Clinical effectiveness and cost-ef-

fectiveness of minimally invasive techniques to manage varicose veins: a systematic review and economic evaluation. Health Technol Assess 2013; 17: i.
[5] Askar O. Surgery of the deep fascia of the leg-I. Subluxation of the deep fascia of the leg, its relation to primary varicose veins, and its surgical treatment. Br J Surg 2010; 52: 107-114.
[6] Hamdan A. Management of varicose veins and venous insufficiency. JAMA 2012; 308: 2612-21.
[7] Geerts WH, Pineo GF, Heit JA, Bergqvist D, Lassen MR, Colwell CW, Ray JG. Prevention of venous thromboembolism: the seventh ACCP conference on antithrombotic and thrombolytic therapy. Chest 2004; 126: 338S.
[8] Subramonia S, Lees TA. The Treatment of varicose veins. Ann R Coll Surg Engl 2007; 89: 96-100.
[9] Shorr AF, Williams MD. Venous thromboembolism in critically ill patients. Observations from a randomized trial in sepsis. Thromb Haemost 2009; 101: 139-144.
[10] Rigby KA, Palfreyman SJ, Beverley C, Michaels JA. Surgery versus sclerotherapy for the treatment of varicose veins. Cochrane Database Syst Rev 2004; 18: CD004980.
[11] Murad MH, Coto-Yglesias F, Zumaeta-Garcia M, Elamin MB, Duggirala MK, Erwin PJ, Montori VM, Gloviczki P. A systematic review and meta-analysis of the treatments of varicose veins. J Vasc Surg 2011; 53: 49S-65S.
[12] Teruya TH, Ballard JL. New approaches for the treatment of varicose veins. Surg Clin North Am 2004; 84: 1397-1417.
[13] van der Velden SK, Pichot O, van den Bos RR, Nijsten TE, De Maeseneer MG. Management strategies for patients with varicose veins (C2-C6): results of a worldwide survey. Eur J Vasc Endovasc Surg 2015; 49: 213-220.
[14] Salem ME. "Salem Operation" - "A new salem endothelial stripping operation" for surgical treatment of primary varicose veins of the lower limbs. Vascular Surgery 1991; 25: 673-676.
[15] Rong JJ, Li XQ, Qian AM, Duan PF, Sang HF, Zhi LW. Endovascular stenting combined with external constriction valvuloplasty of superficial femoral vein for the treatment of chronic venous ulcer in 26 patients. Chinese Journal of Hemorheology 2007.
[16] Nesbitt C, Bedenis R, Bhattacharya V, Stansby G. Endovenous ablation (radiofrequency and laser) and foam sclerotherapy versus open surgery for great saphenous vein varices. Cochrane Database Syst Rev 2014; 7: CD005624.
[17] Kotb MM, Shakiban HK, Sawaby AF. Foam treatment for varicose veins; efficacy and safety. Alexandria Journal of Medicine 2013; 49: 249-253.
[18] Sharma P, Mishra A, Ranjan R. Comparative study of ultrasound guided foam sclerotherapy and surgical management for the treatment of varicose veins. J Am Coll Cardiol 2016; 65: S343-S345.
[19] Cavezzi A, Frullini A, Ricci S, Tessari L, Benedetto S, Tronto D. Treatment of varicose veins by foam sclerotherapy: two clinical series. Phlebology 2002; 17: 13-18.
[20] Darvall KA, Bate GR, Bradbury AW. Patient-reported outcomes 5-8 years after ultrasound-guided foam sclerotherapy for varicose veins. Br J Surg 2014; 60: 1710-1710.
[21] van den Bos RR, Malskat WS, De Maeseneer MG, de Roos KP, Groeneweg DA, Kockaert MA, Neumann HA, Nijsten T. Randomized clinical trial of endovenous laser ablation versus steam ablation (LAST trial) for great saphenous varicose veins. Br J Surg 2014; 101: 1077.
[22] Rigby KA, Palfreyman SJ, Beverley C, Michaels JA. Surgery versus sclerotherapy for the treatment of varicose veins. Cochrane Database Syst Rev 2004; 18: CD004980.
[23] Partsch H, Wininger J, Lun B. Compression stockings reduce occupational leg swelling. Dermatol Surg 2010; 30: 737-743.
[24] Khoshgoftar Z, Esfahani FA, Marzban M, Omran AS, Ghasemi AH, Movaghar S, Saadat S. Comparison of compression stocking with elastic bandage in reducing postoperative edema in coronary artery bypass graft patient. J Vasc Nurs 2009; 27: 103-106.
[25] Protz K, Heyer K, Dorler M, Stucker M, Hampelkalthoff C, Augustin M. Compression therapy: scientific background and practical applications. J Dtsch Dermatol Ges 2014; 12: 794-801.
[26] Houtermans-Auckel JP, van Rossum E, Teijink JA, Dahlmans AA, Eussen EF, Nicolaï SP, Welten RJ. Eur J Vasc Endovasc Surg 2009; 38: 387-391.
[27] Chassagne F, Molimard J, Convert R, Giraux P, Badel P. Numerical approach for the assessment of pressure generated by elastic compression bandage. Ann Biomed Eng 2016; 44: 3096-3108.
[28] Hanna R, Bohbot S, Connolly N. A comparison of interface pressures of three compression bandage systems. Br J Nurs 2013; 17: 16-24.
[29] Zaleska M, Olszewski WL, Durlik M. The effectiveness of intermittent pneumatic compression in long-term therapy of lymphedema of lower limbs. Lymphat Res Biol 2014; 12: 103.
[30] Dennis M, Sandercook P, Reid J, Graham C, Forbes J, Murray G. Effectiveness of intermittent pneumatic compression in reduction of risk of deep vein thrombosis in patients who have had a stroke (CLOTS 3): a multicentre

randomized controlled trial. Lancet 2013; 382: 516-524.
[31] Pavon JM, Adam SS, Razouki ZA, McDuffie JR, Lachiewicz PF, Kosinski AS, Beadles CA, Ortel TL, Nagi A, Williams JW Jr. Effectiveness of intermittent pneumatic compression devices for venous thromboembolism prophylaxis in high-risk surgical patient: a systematic review. J Arthroplasty 2016; 31: 524-532.
[32] Taradaj J, Rosinczuk J, Dymarek R, Halski T, Schneider W. Comparison of efficacy of the intermittent pneumatic compression with a high- and low-pressure application in reducing the lower limbs phlebolymphedema. Ther Clin Risk Manag 2015; 11: 1545-1554.
[33] Chen AH, Frangos SG, Kilaru S, Sumpio BE. Intermittent pneumatic compression device physiological mechanisms of action. Eur J Vasc Endovasc Surg 2001; 21: 383-392.
[34] Smith PC. Chronic venous disease treated by ultrasound guided foam sclerotherapy. Eur J Vasc Endovasc Surg 2006; 32: 577-583.
[35] Rasmussen L, Lawaetz M, Serup J, Bjoern L, Vennits B, Blemings A, Eklof B. Randomized clinical trial comparing endovenous laser ablation, radiofrequency ablation, foam sclerotherapy and surgical stripping for great saphenous varicose veins. British Journal of Surgery 2011; 98: 1088-1088.
[36] Adderley U, Stubbs N. Stockings or bandages for leg-ulcer compression. Nursing Times 2014; 110: 19.
[37] Eklöf B, Rutherford RB, Bergan JJ, Carpentier PH, Gloviczki P, Kistner RL, Meissner MH, Moneta GL, Myers K, Padberg FT, Perrin M, Ruckley CV, Smith PC, Wakefield TW; American Venous Forum International Ad Hoc Committee for Revision of the CEAP Classification. Revision of the CEAP classification for chronic venous disorders: consensus statement. J Vasc Surg 2004; 40: 1248-1252.