JUSTIFICATION OF THE NEED FOR
CHANGING THE CEAP CLINICAL
CLASSIFICATION OF VARICOSE DISEASE OF
THE LOWER EXTREMITIES AND ADAPTING
IT TO THE SURGICAL APPROACH AND THE
SELECTION OF THE EXTENT OF THE
OPERATION

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Abstract. The results of the examination and surgical treatment of 132 patients with CEAP class C2-C6 varicose disease of the lower extremities have been analyzed. A combined diagnostic method that allows detecting the peculiarities of the functioning of the perforating vein venous system of the shin, namely, allows establishing the uncompetency of the perforating veins of the shin objectively, has been developed. In view of the examination results obtained, a method of radical surgical treatment has been developed that allows individualizing, standardizing and synchronizing the extent of the surgical intervention depending on the stage of the disease, which results in a decrease in the injury rate and the duration of the operative intervention, ensuring the best results in the near and remote postoperative periods. A change in the CEAP classification has been proposed in order to adapt it to the surgical approach with a need to single out three clinical variants of stage С6: С6a, С6b and С6c, as well as the need to verify the competent “re-entry” perforating veins and the incompetent perforating veins of the shin while designating them with “Apc” and “Apun” symbols respectively. In view of the innovations proposed an algorithm of the approach and selection of the extent of the surgical treatment of varicose disease depending on its clinical course has been developed.

Key words: varicose disease of the lower extremities, classification, diagnostics, surgical treatment, perforating veins «re-entry».

Introduction

Varicose disease of the lower extremities (VDLE) remains a serious medical, social and economic issue, which is due to the wide occurrence of this disease present in over 20% of the population of the economically developed countries of the world, as well as the increase in the number of complicated forms, which are the main reason of the steady deterioration of the quality of life (Pavlov, 2009; Rabe, 2009; Smita, 2012).

The surgical treatment of the VDLE is becoming ever less aggressive, and the standard intervention is giving ever more place to “map” surgery, which map is plotted based on the data of Doppler echosonography, which allows being restricted to the removal of only the affected venous segments with an incompetent valve system whose varicose transformation is irreversible (Ramele, 2008; Ricci, 2015).

The implementation of ultrasound examination methods in the clinical practice provided the opportunity to discover the boundaries of the true varicose transformation of the great and small saphenous veins of the lower extremities. Of particular significance are the complications of the VDLE in patients with the chronic venous insufficiency (CVI) of the lower extremities, which include patients with C4b-C6 clinical forms according to the CEAP classification.

It has been proven that blood reflux through the incompetent perforating veins, in particular, shin veins, plays the leading role in the pathogenesis of trophic disturbances accompanying the CVI. Its elimination results in the healing of trophic ulcers and prevents their return for years in 80% of cases (Bogdanets, 2009; Jones, 1996; Saveliev, 1972).

Instrumental examination methods are currently used to diagnose perforating shin vein uncompetency accompanying varicose disease. The most informative is the method of perforating vein state assessment
using pulse ultrasonic Doppler examination combined with the Valsalva maneuver and the cuff decompression of the ankle (Coleridge-Smith, 2006). The method specified is not precise, since despite the fact that it allows diagnosing perforating vein dilation and the existence of backflow from the system of the surface veins of the lower extremity to the system of the deep ones, it still does not allow determining whether it is a competent “re-entry” vein or an uncompetent (abnormal) perforating vein.

The crossectomy surgery with the stripping of the great and/or small saphenous vein(s) combined with flow removal is a radical method of VDLE treatment (Fronek, 2010; Savelyev, 2001). At the same time, a number of issues having to do with the technique and extent of the surgical intervention remain unsolved or disputable. For instance, the frequent intraoperative injuries of the n. saphenus and the n. suralis during long stripping, the risk of development of tissue necrosis around the internal surface of the shin, lymph efflux disturbances, the duration and injury rate of the intervention, the insufficient cosmetic effect in the remote postoperative period counter-balance the success of the treatment (Palamarchuk, 2010). The various approaches of surgeons to the selection of the extent of the operation with a shin trophic ulcer in place result in the aggravation of status localis in the near postoperative period in a number of cases, which compels to carry out long-term conservative treatment and justifies the need for solving this issue (Usenko, 2014). Moreover, the introduction of new, non-invasive methods of preoperative ultrasound diagnostics of the state of the lower extremity venous bed has allowed reconsidering the peculiarities of the functioning of the venous system during varicose disease and has become an incentive for the search for new methods and the reconsideration of the extents of the operative treatment of the condition (Bachoo, 2009; Mishalov, 2012; Malas, 2014). The issues of the application of varicose vein radio frequency ablation, as well as minimally invasive surgical correction methods remain unsolved (Nurmeev, 2014; Rasnussen, 2010).

Treating the VDLE successfully is impossible without using an effective clinical classification of the condition. The most widely used in practice is CEAP (Hawaii) clinical classification. The fundamentals of the CEAP classification include a description of the clinical class (C) based upon objective signs, the etiology (E), the anatomical (A) distribution of reflux and obstruction in the superficial, deep and perforating veins, and the underlying pathophysiology (P), whether due to reflux or obstruction (Porter, 1995). Designed to be a document that would evolve over time CEAP underwent its first official review and revision by an international panel under the auspices of the American Venous Forum in 2004 (Eklof, 2004). The revised document retains the basic CEAP categories, but improves the underlying details. Furthermore, to encourage wider usage among clinicians, an abbreviated version or "basic CEAP" was adopted as an alternative to the comprehensive CEAP (Meissner, 2007). Currently, the existing version of CEAP classification does not meet all the requirements of surgeons, not enabling to determine the approach and apply some modern surgical interventions or others (Eklof, 2009; Chernuha, 2010).

In our opinion, the detection of the peculiarities of the preoperative examination of lower extremity veins and a justified change in the approaches to the surgical correction of varicose disease will allow customizing the selection of the extent of the operation depending on the stage of the disease, standardizing the performance and decreasing the injury rate and duration of the intervention, creating the best conditions for the stabilization of the course and the fastest healing of the trophic ulcer and improving the cosmetic effect after the operation.

**The aim of the research**

To improve the preoperative diagnostics method for perforating vein competency in patients with varicose disease of the lower extremities and develop a low-trauma method of radical surgical treatment. To adapt the CEAP clinical classification of varicose disease of the lower extremities to the surgical approach and the selection of the extent of the operation depending on the detected peculiarities of the functioning of the venous system.

**Method**

132 patients with CEAP class C2-C6 VDLE, who were being treated in the surgery department based on the Char of Surgery and Minimally Invasive Technologies of the State Institute “Zaporozhye Medical Academy of Postgraduate Education of Ministry of Health of Ukraine” have been included in the study.

There were 91 women (68.9%) and 41 men (31.1%). The patients’ age amounted to 46.3±4.5 years on average, and the duration of the condition – 18.3±5.1 years. The reason for the patients’ application to the in-patient hospital was VDLE.
The patients have been distributed as follows depending on the class of VDLE: C2 – 8 (6.06%), C3 – 47 (35.6%), C4a – 33 (25.0%), C4b – 32 (24.3%), C5 – 4 (3.0%), C6 – 7 (5.3%) patients. The trophic ulcers were mostly situated in the medial malleolus area, their size not exceeding 3 cm in diameter and amounting to 2.5±0.4 cm on average, whereas the duration of their existence amounted to 0.5 months to 5 years. The clinical severity of the condition was 5 to 21 points according to Rutherford (2000).

All the patients underwent ultrasound duplex scanning of lower extremity veins using Logic C-5 device. The patency of deep veins, the existence of venovenous reflux, the establishment of the boundaries of the reflux distribution in trunk saphenous veins, the degrees of manifestation of degenerative changes in the venous system of the main veins, the identification of the exact localization, diameter and the existence of reflux in perforating veins were assessed.

**Results**

All the patients underwent surgical treatment of VDLE. The patients were divided into 2 clinical groups:

1) the first (control) group – 22 patients (16.7%) with true uncompetency of the perforating veins of the shin, who underwent crossectomy, long GSV trunk stripping, collateral phlebectomy and shin perforating vein ligation;

2) the second (index) group – 110 patients (83.3%) with competent (“re-entry”) perforating veins, who underwent radical surgical intervention using the developed method: crossectomy, short GSV trunk stripping with Boyd perforating vein removal and Muller collateral mini-phlebectomy.

The technical peculiarities of the performance of the operation proposed:

A) the access to the “cross” area – a 3-4 cm long incision in the inguinal fold, which ensures:

- a precise opening to the flow area;
- the minimum length of the skin incision due to the thin layer of subcutaneous fat in this area;
- the maximum cosmetic effect.

B) the Muller saphenous vein collateral mini-phlebectomy (the “stab incision” technique that calls for making skin punctures or cuts whose length amounts to 1/5 of the diameter of the varicose vein being removed (0.5-4 mm)).

According to the data of the preoperative ultrasound duplex scanning, all the patients had patent deep veins. The great saphenous vein diameter on the extremity affected on the hip level was 13.2±2.37 mm, that on the shin – 11.6±3.21 mm. The diameter of the small saphenous vein was 2.7±1.71 mm. The ostial valves of the saphenofemoral junction were uncompetent in 129 patients (97.7%), those of the saphenopopliteal junction – in 21 patients (15.9%).

An increase in the internal diameter of perforating shin veins and the existence of backflow has been detected in patients of both groups in the upright position.

At the same time, these figures were as follows in the patients of the first group: Cockett perforating vein 1 – 3.1±0.36 mm, Cockett 2 – 3.6±0.13 mm, Cockett 3 – 3.3±0.21 mm, Sherman – 4.1±0.19 mm. An increase in the internal diameter of perforating veins was also observed in the patients of the second group: Cockett 1 – 3.2±0.23 mm, Cockett 2 – 3.3±0.31 mm, Cockett 3 – 3.2±0.17 mm, Sherman – 4.0±0.28 mm.

A repeated duplex scanning of perforating shin veins has been performed after the emptying of the veins in prone position and the application of a tourniquet in the upper third of the shin distal of the tourniquet applied using the above method. The vein diameter in the patients of the first groups did not decrease reliably, which evidenced the existence of true shin perforating vein uncompetency, the average values amounting to: 3.0±0.22 mm for Cockett 1, 3.4±0.29 mm for Cockett 2, 3.3±0.22 mm for Cockett 3, 3.9±0.39 mm for Sherman. A reliable decrease in the perforating vein diameter was observed in the patients of the second group: 2.2±0.1 mm for Cockett 1, 2.0±0.1 mm for Cockett 2, 2.1±0.2 mm for Cockett 3, 1.9±0.46 mm for Sherman.

A method of shin perforating vein uncompetency diagnostics during varicose disease of the lower extremities (Declaration Patent of Ukraine # 70282) has been developed. The method allows carrying out differential diagnostics between a competent and uncompetent shin perforating vein. This allows avoiding the removal of an unchanged area of the saphenous vein during the operation, which lowers the injury rate and decreases the duration of the operation and the recovery.

The method is applied as follows: with the patient in an upright position, a duplex Doppler examination of the shin perforating veins is performed. The increase in the internal diameter of the saphenous vein and the perforating veins, as well as the existence of backflow is diagnosed and measured then. Then, the patient is transferred to a dorsal position, the veins of their lower extremity being emptied by lifting the latter at an angle of 45-60° and making massage movements from the foot to the inguinal fold along the saphenous veins.
of the extremity for 1-2 minutes. After that, a venous tourniquet is twisted in the upper third of the shin at a distance of 30-35 cm of the plantar surface of the foot, i.e. proximal of the non-centered Sherman perforating vein of the Leonardo vein and distal of the centered direct Boyd perforating vein of the great saphenous vein. The patient is transferred to an upright position and a duplex Doppler examination of the shin perforating veins is performed distal of the tourniquet twisted. The internal diameter of the perforating vein and the blood flow direction are measured. If the internal diameter of the shin perforating veins decreases and there is no backflow in the dopplergrams, the shin perforating veins are recorded as competent. If the internal diameter of the perforating veins increases and there is a backflow, a shin perforating vein uncompetency is determined.

The peculiarities of the functioning of the venous system during varicose disease have been established in view of the results obtained during the examination of the patients using the diagnostic method developed, which allowed developing a method for radical surgical intervention (Declaration Patent of Ukraine # 78009).

Discussion

An analysis of the data showed that true uncompetency with an abnormal reflux was observed only in 22 (16.7%) of the 132 patients with initial increase in the internal diameter of the shin perforating veins. The internal diameter of the perforating veins decreased and there was no backflow in 110 patients (83.3%), which evidenced their competency (“re-entry” perforating veins).

The results of a preoperative examination showed that the difference in figures during sampling without and with tourniquets in the first group was statistically significant (P<0.05), and that in the second one – statistically non-significant (P>0.05). It has been established that the difference in the figures between the groups during sampling with tourniquets was statistically significant (P<0.05), which evidences the existence of “re-entry” perforating veins in the patients of the first group.

Thus, the patients having “re-entry” shin perforating veins have no indications for their removal or bandaging during operations.

The justification for the development of the operation method specified was provided by theoretical information, in particular:

- the GSV trunk has no centered direct perforating veins below the knee, which excludes the need for performing a phlebectomy;
- the non-centered direct perforating veins of v.Leonardo (the posterior accessory GSV of the shin) are “re-entry” perforants in 85-90% of cases, so the indications for removal include the internal vein diameter exceeding 4 mm and/or CEAP C5-6 trophic disturbances;
- the most distal centered direct perforating vein of the GSV is the Boyd perforating vein in the upper third of the shin, which determines the distal point for the performance of the GSV trunk stripping;
- the SSV trunk is affected in as little as 15% of cases, so its removal is justified if the internal diameter is over 4.5 mm;
- the absence of a perforating vein under the ulcer base with chronic trophic ulcer in 85.7% of cases.

This allows limiting the length of the GSV trunk removal with the performance of a short stripping with the distal intervention point localized 6 cm below the top of the kneecap with the removal of the Boyd perforating vein; performing the intervention on v.Leonardo and the perforating vein bandaging on the shin only in case of indications determined according to the results of the preoperative performance of a duplex Doppler examination of the veins or clinical data; performing the intervention on the SSV trunk only in case of indications determined according to the results of the preoperative performance of a duplex Doppler examination of the veins; limiting the intervention volume on the great saphenous vein trunk in patients with a chronic trophic ulcer of the shin with the performance of a short stripping, and if there are indications, performing an additional collateral phlebectomy.

The extent of the typical variant of the operation proposed consists in the performance of a crossecotomy, a short stripping of the great saphenous vein with the deletion of the Boyd perforating vein and Muller mini-phlebectomy.

On the 5th day after the operation using the method developed, the internal diameter values of the perforating veins on the shin were no different from the values for healthy people and were as follows: 2.1±0.73 mm for Cockett 1, 2.0±0.65 mm for Cockett 2, 2.2±0.41 mm for Cockett 3 and 2.1±0.36 mm for Sherman respectively.

12 and more months into the postoperative period, complete disappearance of pain syndrome, shin edema and trophic ulcer were observed in all patients.
Consequently, the results of postoperative ultrasound duplex Doppler examination of the perforating veins of the shin and the clinical examination data evidence the correctness of the justification of the extent of the operation performed using the method proposed.

Thus, the surgical treatment method developed for varicose disease of the lower extremities is radical and allows decreasing the injury rate and the duration of the operation, as well as achieving better cosmetic results.

The established peculiarities of the functioning of the venous system in patients with varicose disease, the theoretic and practical justification for the change in the extent of operative intervention in various clinical settings have served as the basis for changing the CEAP classification with a view to adapting it to the surgical approach. To this end, we have proposed the following:

1) to single out three variants of stage С6: С6а, С6b and С6c;
2) to specify the backflow mechanism in perforating veins (Ap) while describing them (competent “re-entry” perforating veins or uncompetent perforating veins) by adding a “с” (“competent”) or “un” (“uncompetent”) sign to the well-known Ap symbol. Consequently, competent “re-entry” perforating veins should be designated as Apc, and uncompetent perforating veins as Apun. This allows selecting the approach to and extent of the operation of shin perforating veins:
   - С6а (“re-entry” perforating veins) – operation not indicated;
   - С6b (uncompetent shin perforating veins outside the ulcer localization) – a mini-phlebectomy with perforating vein bandaging;
   - С6c (uncompetent shin perforating veins right under the ulcer base) – perforating vein endoscopic bandaging.

An algorithm for the approach to and the selection of the extent of varicose disease surgical treatment depending on the clinical course of the disease has been developed (Fig. 1).

**Fig. 1.** The algorithm for the approach to and the selection of the extent of the surgical treatment of VDLE

Thus, the implementation of the changes proposed allows synchronizing the approach to and the extent of surgical intervention with all the clinical variants of the course of VDLE.

**Conclusion**

The method proposed ensures greater diagnostic precision in comparison with the methods proposed before and allows diagnosing shin perforating vein uncompetency during VDLE using direct objective signs and detecting normal “re-entry” perforating veins. The application of the developed preoperative method of perforating vein competency diagnostics in patients with VDLE prevents the removal of unchanged sections of the great saphenous vein during the operation, which lowers the injury rate, decreases the duration of the

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\begin{align*}
\text{VDLE: C2 (varicose veins) } & \pm \\
\text{C3 (edemas) } & \pm \\
\text{C4 (skin lesions) } & \\
\text{C5/6 (ulcer) } & \\
\text{Ad, Es: } & - \text{conservative therapy} \\
& - \text{surgical correction} \\
\text{As 2/ As 3: crossectomy + short stripping/ GSV trunk radio frequency obliteration} & \quad \text{As 4: SSV trunk stripping} \\
\text{Ap17: short stripping/ GSV trunk radio} & \quad \text{As 5: collateral mini-phlebectomy} \\
\text{frequency obliteration} & \\
\text{Ap18: “re-entry” perforating veins (C2-5, Apc/ C6a, Apc):} & \\
& - \text{intervention not indicated;} \\
& - \text{perforating vein uncompetency (C2-5, Apun/C6b, Apun):} \\
& \quad \text{mini-phlebectomy + perforating vein bandaging;} \\
& - \text{perforating vein uncompetency (C2-5, Apun/ C6c, Apun):} \\
& \quad \text{perforating vein endoscopic bandaging}
\end{align*}
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operation, lowers the severity of pain syndrome in the postoperative period, decreases the recovery period and allows achieving a better cosmetic effect.

The established peculiarities of venous system functioning during VDLE allow individualizing, standardizing and synchronizing the extent of surgical intervention depending on the stage of the condition. The developed method of surgical treatment of VDLE is radical, allows decreasing the injury rate and the duration of the operative intervention and ensures the best results in the near and remote postoperative periods.

A change in the CEAP classification has been proposed in order to adapt it to the surgical approach with a need to single out three clinical variants of stage С6 (С6а, С6б and С6с), as well as the need to verify the competent “re-entry” perforating veins and the incompetent perforating veins of the shin while designating them with “Арс” and “Арпн” symbols respectively. In view of the innovations proposed an algorithm of the approach and selection of the extent of the surgical treatment of VDLE depending on its clinical course has been developed.

References


