UDC 616.147.3-007.64:616-005-092
DOI: 10.14739/2310-1210.2026.1.340601

Clinical and pathophysiological characteristics of hemodynamic alterations in patients with lower extremity varicose veins

M. V. Druzhkin[1,2,A–E], **A. V. Klymenko**[1,A,E,F]

[1]Zaporizhzhia State Medical and Pharmaceutical University, Ukraine, [2]LLC "KRAM INVEST", Zaporizhzhia, Ukraine

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

Keywords: chronic venous disease of the lower extremities, vascular disease, operative surgical procedures, endovenous ablation, venous duplex scanning, varicose veins, venous insufficiency.

Zaporozhye Medical Journal. 2026;28(1):30-36

Chronic venous disease (CVD) of the lower extremities, specifically at the stage of chronic venous insufficiency, is a prevalent condition among adults characterized by a progressive clinical course and declining quality of life. This necessitates a detailed assessment of hemodynamic changes within the venous system.

Aim. To identify the clinical and pathophysiological features of hemodynamic changes prior to surgery and determine their association with the clinical class of the disease.

Materials and methods. The study included 139 patients (aged 18–75 years) with CVD classes C3–C6 (CEAP classification). Patients were divided into three groups with subgroups based on the treatment method. Assessment included clinical examination, duplex scanning (measuring diameters of the saphenofemoral and saphenopopliteal junctions (SFJ and SPJ), great and small saphenous veins (GSV and SSV), tributaries, and perforators). Disease severity was evaluated using the Venous Clinical Severity Score (VCSS), and quality of life using the Chronic Venous Insufficiency Questionnaire (CIVIQ-20). Statistical analysis utilized Student's t-test and Pearson correlation coefficient (r).

Results. A statistically significant direct correlation was found between higher CEAP clinical classes and worsening CIVIQ-20 and VCSS scores ($p < 0.05$). Duplex ultrasound revealed a strong positive correlation between disease progression and increased diameters of the GSV, SSV, SFJ, and SPJ, as well as a greater number and size of tributaries and perforators with pathological reflux. The number of affected anatomical segments in the superficial venous system also increased with disease severity.

Conclusions. Combined analysis of duplex data, CIVIQ-20, and VCSS is critical for optimal surgical decision-making. Future studies should prioritize elucidating the biochemical mechanisms underlying CVD progression and assessing the long-term outcomes associated with various surgical approaches.

Ключові слова: варикозна хвороба нижніх кінцівок, захворювання судин, хірургічне лікування, ендовенозна абляція, дуплексне сканування вен, варикозне розширення вен, венозна недостатність.

Запорізький медичний журнал. 2026. Т. 28, № 1(154). С. 30-36

Клінічні та патофізіологічні особливості гемодинамічних змін у пацієнтів із варикозною хворобою нижніх кінцівок

М. В. Дружкін, А. В. Клименко

Варикозна хвороба нижніх кінцівок (ВХНК) у стадії хронічної венозної недостатності – одна з найпоширеніших патологій у дорослого населення. Клінічний перебіг ВХНК швидко прогресує і спричиняє зниження якості життя. Це обґрунтовує необхідність детального вивчення гемодинамічних змін венозного русла.

Мета роботи – визначити клінічні та патофізіологічні особливості цих змін до оперативного лікування та встановити їх взаємозв'язок із клінічним класом хвороби.

Матеріали і методи. До дослідження залучили 139 пацієнтів віком від 18 до 75 років із ВХНК класів С3–С6 за класифікацією CEAP. Обстежених поділили на три групи (з підгрупами) залежно від способу лікування. Здійснили загальноклінічне обстеження залучених до дослідження пацієнтів, виконали дуплексне сканування з оцінюванням діаметрів сафено-феморального та сафено-поплітеального з'єднань, великої та малої підшкірних вен, притокових і перфорантних вен, визначили клінічну тяжкість перебігу захворювання за шкалою Venous Clinical Severity Score (VCSS), оцінили якість життя за опитувальником Chronic Venous Insufficiency Questionnaire (CIVIQ-20), застосували статистичні методи (t-критерій Стьюдента, коефіцієнт кореляції Пірсона).

Результати. Встановлено, що підвищення клінічного класу ВХНК за класифікацією CEAP має достовірний прямий кореляційний зв'язок зі зниженням якості життя пацієнтів за CIVIQ-20 і поглибленням тяжкості клінічного перебігу хвороби за VCSS. Дані дуплексного сканування дали змогу встановити прямий позитивний кореляційний зв'язок між ступенем порушення кровотоку та підвищенням клінічного класу ВХНК ($p < 0.05$). Так, визначено достовірне збільшення діаметрів великої та малої підшкірних вен, сафено-феморального з'єднання, сафено-поплітеального з'єднання, а також кількості та розмірів притокових, перфорантних вен із патологічним гемодинамічним рефлюксом, кількості уражених анатомічних ділянок системи поверхневих вен нижніх кінцівок.

Висновки. Комплексне оцінювання даних дуплексного сканування, показників якості життя за CIVIQ-20 і тяжкості перебігу захворювання за VCSS є ключовим під час визначення тактики хірургічного лікування. Доцільно продовжити дослідження біохімічних механізмів прогресування ВХНК і віддалених результатів хірургічного лікування.

Chronic venous disease (CVD) of the lower extremities is among the most prevalent pathologies affecting the adult population globally, involving approximately 25 % of women and 15 % of men. In Ukraine, the prevalence among adults reaches 30 %, with 25 % of these cases occurring in working-age individuals [1].

The clinical manifestations of CVD range from asymptomatic cosmetic concerns to severe pain and the development of complications such as chronic venous insufficiency (CVI) or acute superficial venous thrombosis [2]. Depending on the clinical class of CVD, characteristic visual markers include telangiectasias, reticular veins, varicose veins, oedema, skin hyperpigmentation, lipodermatosclerosis, atrophie blanche, and venous ulceration [3,4,5].

According to the CEAP classification, the combined prevalence estimates for CVD are as follows: C3 – 8 %, C4 – 4 %, C5 – 1 %, and C6 – 0.4 % of the general population [6].

A study by Z. Krasiński & B. Krasińska reported that C2-class CVD is observed in 25–40 % of adults, whereas advanced stages (C3–C6) are present in 17–20 % of the population [7].

Consequently, nearly 20 % of patients exhibit clinical classes of the disease associated with CVI (C3-C6 according to the CEAP classification).

Surgical intervention is generally indicated from clinical class C2 onwards, with endovenous radiofrequency ablation (RFA) or endovenous laser ablation (LA) serving as the primary treatment modalities. These procedures are applied to the trunks of the great saphenous vein (GSV) and/or small saphenous vein (SSV), either in isolation or combined with the treatment of tributaries and perforating veins [8,9].

Despite these advancements, surgical outcomes are not always optimal. Recurrence is observed in up to 60 % of patients. Postoperative complications, including deep vein thrombosis (DVT), wound hematomas, and persistent ulceration, occur in up to 18 % of cases [10,11], while a significant impairment in the quality of life is reported by 32.5 % of patients [12].

It is widely recognized that the success in the surgical management of CVD depends on the accurate identification of hemodynamic pathophysiology within the superficial, deep, tributary, perforating, and communicating venous systems. This requires precise anatomical mapping of the affected segments and the detection of associated complications [13,14,15].

Currently, duplex ultrasound (DUS) of the lower limb veins is the key diagnostic tool for identifying these pathological changes, enabling the selection of the appropriate surgical technique and extent of correction [16,17]. However, several areas remain insufficiently addressed, including the comprehensive evaluation of preoperative DUS findings, the correlation between uncorrected hemodynamic abnormalities and disease recurrence, the impact of specific hemodynamic patterns on long-term clinical outcomes. Further investigation is required to optimize the selection of surgical methods based on preoperatively identified hemodynamic profiles.

Aim

To identify the clinical and pathophysiological features of hemodynamic changes prior to surgery and determine their association with the clinical class of the disease.

Materials and methods

The study enrolled patients with CVD at the stage of CVI, classified as clinical class C3–C6 according to the CEAP classification, aged 18 to 75 years. The cohort consisted of 47 (33.8 %) males and 92 (66.2 %) females.

Inclusion criteria: patients with CVD clinical classes C3–C6 (CEAP), aged 18–75 years. Exclusion criteria: patients with CVD clinical classes C0-C2; age <18 or >75 years; presence of oncological, autoimmune, or hepatic diseases; diabetes mellitus; and refusal to provide informed consent.

A total of 139 (100 %) patients were examined and categorized into three clinical groups:

– Group 1 (main group, n = 32, 23.0 %): patients who underwent endovenous RFA of the GSV and/or SSV trunks, combined with miniphlebectomy of tributary and perforating veins;

– Group 2 (comparison group, n = 64) was divided into two subgroups: subgroup 2a (n = 31, 22.3 %) – patients who underwent endovenous RFA combined with miniphlebectomy of tributary veins without perforator ligation; subgroup 2b (n = 33, 23.7 %) – patients who underwent endovenous RFA combined with ligation of perforating veins without tributary miniphlebectomy;

– Group 3 (comparison group, n = 43, 30.9 %): patients who were treated exclusively with endovenous RFA of the GSV and/or SSV trunks.

The patients underwent comprehensive clinical, instrumental, and laboratory examinations at the Department of Faculty Surgery of Zaporizhzhia State Medical and Pharmaceutical University.

Clinical status of patients with CVD was evaluated using the international CEAP classification, which incorporates clinical signs (C), etiologic factors (E), anatomic distribution (A), and pathophysiologic mechanisms (P) of CVD [18].

Ultrasound examinations of the lower limb vessels were performed using an ACUSON NX3 Elite system (Siemens Medical Solutions USA, Inc.) in accordance with the American Venous Forum (2023) and European Society for Vascular Surgery (2022) guidelines.

Examinations were performed in the standing position (or, if not feasible, in a position simulating venous loading). Reflux was provoked using the Valsalva manoeuvre for the saphenofemoral junction (SFJ) and distal compression-release for more distal segments. Reverse flow was measured using spectral Doppler, recording both the duration (seconds) and peak reflux velocity [19].

The assessed parameters included the diameters of the SFJ, GSV at the distal point of insufficiency (DPI), the number of segments with pathological reflux in the system of the anterior accessory saphenous vein (AASV) and in the Giacomini vein (Gia) region, the diameter of the saphenopopliteal junction (SPJ), SSV at the DPI, and tributary/perforating veins. Mandatory mapping was performed for the SFJ and SPJ, the trunks of the GSV/SSV (proximal, mid, and distal segments), tributary and communicating veins, as well as perforators with specification of the fascial level.

The criteria for determining pathological hemodynamic reflux were as follows: for superficial axial veins (GSV, SSV) – reflux duration >0.5 seconds; for the common femoral, femoral, and popliteal veins – >1.0 second; and for tibial, deep femoral, and perforating veins – >0.5 seconds.

Table 1. Preoperative CIVIQ-20 (invGIS) and VCSS scores in patients with various clinical classes of CVD, M ± m

Clinical class (CEAP)	CIVIQ-20 (invGIS), points	VCSS, points
C3 (n = 66)	75.00 ± 0.49A	8.00 ± 0.17A
C4a (n = 40)	61.70 ± 0.46B	11.25 ± 0.13B
C4b (n = 7)	50.86 ± 1.13C	13.14 ± 0.48C
C4c (n=11)	50.09 ± 1.29C	13.82 ± 0.29CD
C5 (n = 6)	36.50 ± 1.19D	15.17 ± 0.57D
C6 (n = 9)	20.56 ± 1.69E	18.99 ± 0.69E

Clinical classes not sharing common superscript letters differ significantly from each other ($p < 0.05$).

A perforating vein was defined as "pathological" if its internal diameter at rest was ≥3.5 mm in combination with an outward-directed flow lasting more than 0.5 seconds.

Quality of life was assessed via the Chronic Venous Insufficiency Questionnaire (CIVIQ-20), which consists of 20 items reflecting four components of quality of life: physical, psychological, social, and pain-related. Results were interpreted using the Inverted Global Index Score (invGIS), where 20 points represent the poorest and 100 points the best possible quality of life [20,21].

The severity of venous pathology was quantified using the Venous Clinical Severity Score (VCSS). The assessment included 10 clinical parameters: pain, varicose veins, venous oedema, skin hyperpigmentation, inflammation, induration, number of ulcers, duration of ulcers, size of ulcers, and adherence to compression therapy. Each parameter was rated from 0 to 3 points depending on severity (absent = 0, mild = 1, moderate = 2, severe = 3). The maximum score was 30, indicating severe venous disease, while the minimum score was 0 [22].

The data obtained were statistically analyzed using the licensed software package Statistica 13,0, TIBCO Software Inc. (license JPZ804I382130ARCN10-J), and Microsoft Excel 2013 (license 00331-10000-00001-AA404) [23]. Quantitative data were presented as M±m (mean ± standard error of the mean). Significance was assessed using Student's t-test for independent samples and paired t-test for intra-group changes. Pearson correlation coefficients were calculated for normally distributed data [23]. The significance of intergroup and intersubgroup differences was assessed using Student's t-test for independent samples, while Student's paired t-test was applied for evaluating changes over the treatment course. Correlations between indicators were measured using correlation analysis with calculation of Pearson correlation coefficients in cases of normal distribution.

The study was conducted in accordance with current bioethical standards [24], including the provisions of Article 8 of the Law of Ukraine No. 123/96-VR "On Medicinal Products" [25]; the Directive 2001/20/EC of the European Parliament and the Council [26]; the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine [27]; the World Medical Association Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects [28]; the World Health Organization's recommendations "Global Health Ethics" [29]; the principles of Good Clinical Practice (GCP) [30]; and Order of the Ministry of Health of Ukraine No. 690 [31]. All patients provided written informed consent to participate in the study. The study design was approved by the Bioethics Commission of Zaporizhzhia State Medical and Pharmaceutical University (Protocol No. 10, September 18, 2025).

Results

The preoperative assessment of venous disease severity and quality of life in patients across various clinical classes of CVD, specifically stages C3–C6 (according to the CEAP classification), is summarized in *Table 1*.

As shown in *Table 1*, the mean invGIS scores (CIVIQ-20) in patients with clinical class C3 were significantly higher than those in classes C4a ($t = 19.8$, $p < 0.05$), C4b ($t = 19.6$, $p < 0.05$), C4c ($t = 18.1$, $p < 0.05$), C5 ($t = 29.9$, $p < 0.05$), and C6 ($t = 31.0$, $p < 0.05$). Similarly, the mean invGIS values in class C4a patients were significantly higher compared to classes C4b ($t = 8.9$, $p < 0.05$), C4c ($t = 8.5$, $p < 0.05$), C5 ($t = 19.8$, $p < 0.05$), and C6 ($t = 23.5$, $p < 0.05$). However, these scores remained significantly lower than those observed in class C3 patients and healthy individuals.

No statistically significant difference in invGIS scores was observed between clinical classes C4b and C4c ($t = 0.45$, $p > 0.05$). Nevertheless, mean values in class C4b were significantly higher than in classes C5 ($t = 8.8$, $p < 0.05$) and C6 ($t = 14.9$, $p < 0.05$), while being significantly lower than in classes C3 and C4a. When comparing invGIS scores between classes C4c and C5, significantly higher quality-of-life indicators were noted in class C4c ($t = 7.7$, $p < 0.05$).

In the same way, significantly higher invGIS scores were observed in class C4c compared to class C6 ($t = 13.9$, $p < 0.05$). The mean invGIS scores in class C5 were also significantly higher than those in class C6 ($t = 7.7$, $p < 0.05$). The Pearson correlation coefficient between the clinical class of CVD and the quality of life scores on the CIVIQ-20 scale (invGIS) was very strong and negative ($r = -0.979$, $p < 0.05$). Thus, an increase in the clinical severity of the disease was associated with a statistically significant decrease in mean CIVIQ-20 scores, indicating a progressive deterioration in patients' quality of life.

Analysis of the mean VCSS revealed that values were significantly lower in patients with class C3 compared to those with class C4a ($t = 15.2$, $p < 0.05$), C4b ($t = 10.1$, $p < 0.05$), C4c ($t = 17.3$, $p < 0.05$), C5 ($t = 12.1$, $p < 0.05$), and C6 ($t = 15.5$, $p < 0.05$). The scores for class C4a were significantly lower than those for classes C4b ($t = 3.8$, $p < 0.05$), C4c ($t = 8.1$, $p < 0.05$), C5 ($t = 6.7$, $p < 0.05$), and C6 ($t = 11.0$, $p < 0.05$) but remained higher than those in class C3 and the healthy control group. No significant difference was observed between classes C4b and C4c ($t = 1.2$, $p > 0.05$). However, scores in class C4b were significantly lower than those in classes C5 ($t = 2.7$, $p < 0.05$) and C6 ($t = 7.0$, $p < 0.05$). Similarly, no significant difference was found between classes C4c and C5 ($t = 2.0$, $p > 0.05$). Values in class C5 were significantly lower than in C6 ($t = 4.3$, $p < 0.05$) yet significantly higher than in other CEAP classes. The Pearson correlation coefficient between the clinical class of CVD and the VCSS score demonstrated a very strong positive correlation ($r = 0.976$, $p < 0.05$).

These data indicate that a higher clinical class of CVD directly correlates with increased severity of clinical manifestations. The results of the DUS examination of the lower

Table 2. Preoperative morphometric ultrasound parameters of the venous system across clinical classes of CVD, mm (M ± m)

Parameter, units of measurement	Clinical class (CEAP)						Correlation coefficient, r
	C3	C4a	C4b	C4c	C5	C6	
SFJ, mm	9.1 ± 0.7A	10.5 ± 0.9ABF	12.0 ± 1.1BGH	13.4 ± 1.2CFG	15.7 ± 1.2CD	15.1 ± 1.3CEH	0.974
DPI of GSV, mm	8.6 ± 0.5A	9.4 ± 0.6AC	10.2 ± 0.7ABE	11.1 ± 0.7BCD	12.9 ± 0.8D	12.2 ± 0.9BDE	0.953
SPJ, mm	4.9 ± 0.6A	5.3 ± 0.6AB	6.1 ± 0.7ACDE	7.0 ± 0.8BDEF	7.7 ± 0.9CDF	8.2 ± 1.0D	0.995
DPI of SSV, mm	4.7 ± 0.5A	5.1 ± 0.5AB	5.8 ± 0.6AC	6.5 ± 0.7BC	7.0 ± 0.7C	7.5 ± 0.8C	0.996
Tributary veins, mm	4.7 ± 0.3A	4.9 ± 0.4AB	5.2 ± 0.4AB	5.5 ± 0.4AB	5.9 ± 0.4B	5.7 ± 0.4AB	0.995
Perforating veins, mm	4.1 ± 0.3A	4.4 ± 0.2AB	4.9 ± 0.3AC	5.1 ± 0.3BC	5.6 ± 0.2C	5.4 ± 0.4C	0.953

Clinical classes not sharing a common superscript letter differ significantly ($p < 0.05$).

Table 3. Preoperative CIVIQ-20 (invGIS), VCSS, and ultrasound parameters of the venous system across study groups, M ± m

Parameter, units of measurement	Groups			
	Group 1 (main), n = 32	Group 2 (comparison), n = 64		Group 3 (comparison), n = 43
		Subgroup 2A, n = 31	Subgroup 2B, n = 33	
VCSS, points	10.50 ± 0.18	10.70 ± 0.16	10.42 ± 0.27	10.83 ± 0.19
CIVIQ-20, points	61.68 ± 1.02	61.74 ± 1.40	62.12 ± 1.58	63.88 ± 0.85
SFJ, mm	11.72 ± 0.26	11.86 ± 0.24	11.70 ± 0.20	11.49 ± 0.23
DPI of GSV, mm	11.03 ± 0.16	11.31 ± 0.22	11.06 ± 0.16	11.24 ± 0.22
SPJ, mm	6.71 ± 0.14	6.39 ± 0.15	6.45 ± 0.14	6.79 ± 0.15
DPI of SSV, mm	6.80 ± 0.12	6.89 ± 0.13	6.72 ± 0.13	7.03 ± 0.16
Tributaries, mm	5.59 ± 0.13	5.44 ± 0.11	5.35 ± 0.10	5.38 ± 0.11
Perforators, mm	5.30 ± 0.11	5.11 ± 0.10	5.15 ± 0.08	5.32 ± 0.10

Groups not sharing common superscripts differ significantly ($p < 0.05$).

limb venous system in patients with CVD (classes C3–C6) prior to surgical intervention are summarized in *Table 2*.

Analysis of the SFJ mean diameter revealed a statistically significant, progressive increase from class C3 (9.1 ± 0.7 mm) to class C6 (15.1 ± 1.3 mm; $t = 4.1$, $p < 0.05$). Significant differences were observed between all classes except for C3 vs. C4a ($t = 1.2$, $p > 0.05$) and C5 vs. C6 ($t = 0.3$, $p > 0.05$).

The mean diameter of the GSV at the DPI also increased significantly with disease progression, rising from 8.6 ± 0.5 mm in class C3 to 12.2 ± 0.9 mm in class C6 ($t = 3.5$, $p < 0.05$). However, no significant differences were found between classes C4c and C5 ($t = 1.7$; $p > 0.05$), C5 and C6 ($t = 1.0$; $p > 0.05$), or C4c and C6 ($t = 0.6$, $p > 0.05$).

A consistent upward trend was observed for the SPJ diameter, which increased from 4.9 ± 0.6 mm (C3) to 8.2 ± 1.0 mm (C6) ($t = 2.8$, $p < 0.05$) according to the CEAP classification. Similarly, the DPI of the SSV expanded from 4.7 ± 0.5 mm in class C3 to 7.5 ± 0.8 mm in class C6 ($t = 3.0$, $p < 0.05$). For both parameters, the differences between classes C5 and C6 did not reach statistical significance ($t = 0.4$, $p > 0.05$ and $t = 0.5$, $p > 0.05$, respectively).

Ultrasonographic evaluation showed a significant increase in the number of segments of tributary veins and their diameter with the disease progression: from 4.7 ± 0.3 mm in class C3 to 5.7 ± 0.4 mm in class C6 ($t = 2.0$, $p < 0.05$). Assessment of the perforating veins also revealed a statistically significant increase in both their number and diameter with worsening clinical class of CVD according to the CEAP classification: from 4.1 ± 0.3 mm in class C3 to 5.4 ± 0.4 mm in class C6 ($t = 2.6$, $p < 0.05$).

Pearson correlation analysis demonstrated a very strong positive correlation between the CEAP clinical class and all measured ultrasound parameters of hemodynamic impairment ($r > 0.95$, $p < 0.05$).

The distribution of venous reflux sources was analyzed across the AASV system and the Gia region. The analysis demonstrated that an increase in the clinical class of the disease (according to the CEAP classification) was associated with a statistically significant, gradual increase in the mean number of segments with pathological reflux in the AASV: from 3.6 ± 0.2 mm in patients with class C3 to 5.2 ± 0.4 mm in class C6 ($t = 4.5$, $p < 0.05$). A similar trend was observed for the affected segments in the Gia region: from 3.2 ± 0.2 mm in class C3 to 4.4 ± 0.3 mm in class C6 ($t = 3.3$, $p < 0.05$).

These data indicate significant structural and pathophysiological hemodynamic alterations in the lower extremity veins of patients with CVD. These changes correlate directly with the progression of CVI as defined by the CEAP classification. Specifically, higher CEAP classes were associated with increased severity of clinical manifestations (assessed by the VCSS); significant deterioration in quality of life (measured by the CIVIQ-20 questionnaire); progressive increase in venous diameters and a higher prevalence of reflux in specific venous segments according to DUS findings.

The ultrasound findings also demonstrated a direct positive correlation between increasing venous diameter and the progression of the CEAP clinical class.

According to *Table 3*, the mean values of venous segment diameters as well as the CIVIQ-20 and VCSS scores did not differ significantly between the groups and subgroups ($p > 0.05$).

Discussion

CVD of the lower extremities is a progressive condition characterized by irreversible structural changes not only in

the superficial, perforating, and deep venous systems but also in the skin, subcutaneous tissue, muscular, skeletal, and nervous tissues of the limbs [32]. Under the influence of various factors, weakness of the muscular-elastic components of the venous wall develops, valvular incompetence arises, and venous blood outflow slows down, leading to the dilation of subcutaneous veins. This leads to the development of sustained venous hypertension – initially in the main venous trunks, and later in the perforating veins that connect the deep and superficial venous systems. Most researchers consider venous hypertension, which disrupts microcirculation, to be a key factor in the development of trophic skin changes [33,34]. Shrestha B. & Karmacharya R. M. found that in cases of chronic venous disease of the lower extremities, the GSV is the most commonly affected, observed in 77 % of cases [35].

The most widely accepted system for assessing CVD severity is the CEAP classification, proposed in 1994 and updated by the International Consensus Committee. The clinical component (C) reflects symptom severity – ranging from telangiectasias and reticular veins to active trophic ulcers. The etiological section (E) indicates the nature of the disease (congenital, primary, or secondary), while the anatomical component (A) identifies the involved veins (superficial, deep, or perforating). The pathophysiological criterion (P) documents the presence of venous reflux or obstruction [36]. In a study by O. Y. Atamaniuk et al., clinical examination revealed that the largest proportion of patients belonged to class C3, although 19 % exhibited advanced changes characteristic of classes C4–C6 [37]. Furthermore, R. S. Lahel et al. confirmed that GSV diameter correlates significantly with the clinical severity of chronic venous insufficiency, particularly in the thigh and knee regions [38].

Quality of life (QoL) serves as an integral indicator of physical, emotional, and social well-being and is closely linked to CVD severity [39]. QoL is significantly diminished by physical manifestations such as edema, pruritus, and skin discoloration, as well as by aesthetic defects that lead to psychological discomfort, anxiety, and social isolation. This impact is particularly pronounced in women; however, men and younger patients (18–40 years) also frequently report a high emotional burden [40]. Our findings indicate that the impact of CVD on QoL increases proportionally with the CEAP clinical class.

In patients with class C4, the average decrease in QoL across all dimensions (physical symptoms, aesthetics, interpersonal relationships, and emotional burden) was significantly greater than in those with classes C2–C3 ($p < 0.05$). A significantly higher proportion of C4 patients rated their emotional burden and the disease's impact on relationships as high or very high ($p < 0.05$). There was also a notable trend toward a higher impact of physical symptoms and aesthetic disturbances in the C4 group (46–69 % vs. 30–48 % in C2–C3) [41]. Both international and national data align with our findings, identifying a direct negative correlation between the clinical class of CVD and QoL, as confirmed by the decline in the CIVIQ-20 index. Additionally, Q. Yang et al. determined that patients in classes C4–C6 had significantly larger GSV diameters compared to class C1, with reflux duration being statistically longer in C6 patients [42]. Atamaniuk O. Y. et al. also noted a positive association between GSV diameter and VCSS scores [37]. Our results corroborate these trends: as venous outflow disturbances intensify, the clinical class of CVD rises, reinforcing the progressive nature of the pathology.

Thus, these results confirm that the progression of CVD according to the CEAP classification is accompanied by an increase in GSV diameter, worsening clinical manifestations, and a marked decline in quality of life. A comprehensive assessment using the CEAP, VCSS, and CIVIQ-20 scales, combined with duplex ultrasound parameters, is essential for effective risk stratification and the selection of optimal treatment strategies.

Conclusions

1. An increase in the clinical class of chronic venous disease according to the CEAP classification shows a statistically significant negative correlation with patients' quality of life (as evidenced by a decrease in the CIVIQ-20 / invGIS index) and a positive correlation with the severity of clinical manifestations (confirmed by an increase in VCSS scores).

2. Ultrasound-based anatomical indicators and pathophysiological hemodynamic changes demonstrate a strong correlation between the degree of blood flow disturbance and the clinical class of chronic venous disease. Specifically, a significant increase was observed in the diameters of the great saphenous vein, small saphenous vein, and their respective junctions. Furthermore, there was a measurable increase in the number and size of tributary and perforating veins exhibiting pathological reflux, alongside broader involvement of anatomical segments within the superficial venous system of the lower extremities.

3. When selecting a surgical strategy for chronic venous disease, it is essential to integrate the findings of a comprehensive preoperative duplex ultrasound assessment, the specific anatomical location of the affected segments, and the clinical severity of the disease in the context of identified hemodynamic patterns.

Prospects for further research. Future studies should focus on an in-depth investigation of the pathophysiological and biochemical mechanisms underlying the progression of chronic venous diseases. Additionally, the development of innovative surgical approaches and the long-term evaluation of their impact on postoperative quality of life and clinical severity remain high priorities.

Funding
The study was conducted without financial support.

Conflicts of interest: authors have no conflict of interest to declare.
Конфлікт інтересів: відсутній.

Надійшла до редакції / Received: 19.09.2025
Після доопрацювання / Revised: 13.11.2025
Схвалено до друку / Accepted: 17.11.2025

Information about the authors:
Druzhkin M. V., MD, PhD student, Department of Faculty Surgery and Oncology, Zaporizhzhia State Medical and Pharmaceutical University; LLC "KRAM INVEST", Zaporizhzhia, Ukraine.
ORCID ID: 0009-0009-6027-7750

Klymenko A. V., MD, PhD, DSc, Professor, Head of the Department of Faculty Surgery and Oncology, Zaporizhzhia State Medical and Pharmaceutical University, Ukraine.
ORCID ID: 0000-0002-8502-0769

Відомості про авторів:
Дружкін М. В., PhD-аспірант каф. факультетської хірургії і онкології, Запорізький державний медико-фармацевтичний університет, Україна.
Клименко А. В., д-р мед. наук, професор, зав. каф. факультетської хірургії і онкології, Запорізький державний медико-фармацевтичний університет, Україна.

Mykyta Druzhkin (Микита Дружкін)
dr.druzhkin@gmail.com

References

1. Savoliuk SI. Suchasnyj pohlyad na likuvannya uskladnenykh form khronichnoyi venoznoyi nedostatnosti [Internet]. Khirurhiia. Ortopediia. Travmatolohiia. Intensyvna terapiia. 2023;(1) [cited 2025 Sep 19]. Available from: https://health-ua.com/hirurgiya/flebologiia/72731-suchasnij-poglyad-nalku-vannya-uskladnenih-form-hronchno-venozno-nedostatnos. Ukrainian.
2. Aslam MR, Muhammad Asif H, Ahmad K, Jabbar S, Hayee A, Sagheer MS, et al. Global impact and contributing factors in varicose vein disease development. SAGE Open Medicine. 2022;10:20503121221118992. doi: 10.1177/20503121221118992
3. Babaei M, Afrooghe A, Rafati A, Mohebbi B, Moosavi J, Ghadri N, et al. Prevalence and associated factors of chronic venous disease among the modern Iranian urban population. J Vasc Surg Venous Lymphat Disord. 2023;11(6):1098-106.e10. doi: 10.1016/j.jvsv.2023.06.005
4. Wang Y, Li R, Bai L, Zou Z, Zheng C, Peng F, et al. A study of social isolation in patients with varicose veins of the lower extremities: A scoping review. J Tissue Viability. 2024;33(4):930-7. doi: 10.1016/j.jtv.2024.09.012
5. Michaels JA, Nawaz S, Tong T, Brindley P, Walters SJ, Maheswaran R. Varicose veins treatment in England: population-based study of time trends and disparities related to demographic, ethnic, socioeconomic, and geographical factors. BJS Open. 2022;6(4):zrac077. doi: 10.1093/bjsopen/zrac077
6. Salim S, Machin M, Patterson BO, Onida S, Davies AH. Global epidemiology of chronic venous disease: A systematic review with pooled prevalence analysis. Annals of Surgery. 2021;274(6):971-6. doi: 10.1097/SLA.0000000000004631
7. Gao Y, Sun M, Qin J, Wang X. Clinical study of the venous structure and hemodynamic status of patients with varicose veins of the lower limbs by bifunctional ultrasound scanning. Minerva Med. 2025;116(6):510-3. doi: 10.23736/S0026-4806.24.09105-5
8. Atik C, Ozcaliskan O, Atik D. 5-year clinical results of 1073 patients with varicose veins treated using radiofrequency ablation, endovenous laser ablation and cyanoacrylate embolisation. Sanamed. 2023;18(1):45-52. doi: 10.5937/sanamed18-43961
9. Ma Y, Zhang H, Niu L, Feng Y, Zhang C, Zhang F, et al. The long-term efficacy of radiofrequency ablation for varicose veins in patients with iliac vein compression. Asian J Surg. 2024:S1015-9584(24)02697-6. doi: 10.1016/j.asjsur.2024.11.071
10. Pavuk FM, Fedusiak VY, Popovych NM. [Results of complex treatment of patients with chronic venous insufficiency in the stage of decompensation]. Scientific Bulletin of Uzhhorod University. Series Medicine. 2023;(2):101-6. Ukrainian. doi: 10.32782/2415-8127.2023.68.17
11. Rahman MS, Sayem MA, Khan MK, Alam MR, Azad MA. Outcome of varicose vein surgery in a general surgical unit. International Surgery Journal. 2024;11(3):345-9. doi: 10.18203/2349-2902.isj20240565
12. Donmez GS, Basak T. Evaluation of quality of life in patients with varicose veins of the lower extremities. International Journal of Emerging Trends in Health Sciences. 2020;4(1):1-10. doi: 10.18844/ijeths.v4i1.4965
13. Gwozdzinski L, Pieniazek A, Gwozdzinski K. Factors influencing venous remodeling in the development of varicose veins of the lower limbs. Int J Mol Sci. 2024;25(3):1560. doi: 10.3390/ijms25031560
14. Kolosovych IV, Korolova KO, Korolova ZV. Pathophysiological mechanisms of varicose veins in the lower extremities. Fiziologichnyi Zhurnal. 2025;71(1):79-86. doi: 10.15407/fz71.01.079
15. Krasiński Z, Krasińska B. Treatment of early-stage chronic venous disease – management standards for 2023. Polski Przegląd Chirurgiczny. 2023;95(1):64-9. doi: 10.5604/01.3001.0016.2971
16. Hong KP. Correlation of clinical class with duplex ultrasound findings in lower limb chronic venous disease. J Chest Surg. 2022;55(3):233-8. doi: 10.5090/jcs.22.010
17. Sarpe AK, Flumignan CD, Nakano LC, Trevisani VF, Lopes RD, Guedes Neto HJ, et al. Duplex ultrasound for surveillance of lower limb revascularisation. Cochrane Database of Systematic Reviews. 2023;7(7):CD013852. doi: 10.1002/14651858.CD013852.pub2
18. Zegarra TI, Tadi P. CEAP classification of venous disorders [Internet]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025 Jan– [updated 2023 Mar 27; cited 2025 Sep 18]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK557410/
19. Gloviczki P, Lawrence PF, Wasan SM, Meissner MH, Almeida J, Brown KR, et al. The 2022 Society for Vascular Surgery, American Venous Forum, and American Vein and Lymphatic Society clinical practice guidelines for the management of varicose veins of the lower extremities. Part I. Duplex scanning and treatment of superficial truncal reflux: Endorsed by the Society for Vascular Medicine and the International Union of Phlebology. J Vasc Surg Venous Lymphat Disord. 2023;11(2):231-261.e6. doi: 10.1016/j.jvsv.2022.09.004
20. Darwis P, Pratama D, Muradi A, Hamzah A, Rizqhi F, Satriadinatha GB. Adaptation of the CIVIQ-20 Questionnaire as a measurement instrument on quality of life in chronic venous insufficiency patients in Jakarta, Indonesia. Chirurgia. 2024;37(4):243-6. doi: 10.23736/S0394-9508.23.05666-8
21. Launois R, Mansilha A, Jantet G. International psychometric validation of the Chronic Venous Disease Quality of Life Questionnaire (CIVIQ-20). Eur J Vasc Endovasc Surg. 2010;40(6):783-9. doi: 10.1016/j.ejvs.2010.03.034
22. Bai H, Storch JB, Gokani V, Kibrik P, Chen J, Ting W. Identifying venous clinical severity score thresholds for Clinical-Etiology-Anatomy-Pathophysiology classifications of venous edema and higher. Vascular. 2024 Dec;32(6):1322-1329. doi: 10.1177/17085381231193510
23. Fetisov VS. Paket statystychnoho analizu danykh STATISTICA (Statistical data analysis package STATISTICA). Nizhyn: Mykola Gogol Nizhyn State University; 2018. 114 p. Ukrainian.
24. Tereshkevych HT. Osnovy bioetyky ta biobezpeky [Fundamentals of bioethics and biosafety]. Ternopil: TDMU; 2018. 400 p. Ukrainian.
25. Verkhovna Rada of Ukraine. On Medicinal Products. Law of Ukraine dated 1996 Apr 4 No. 123/96-BP. [cited 2025 Mar 8]. Available from: https://zakon.rada.gov.ua/laws/show/123/96-вр#Text
26. European Parliament and Council of the European Union. Directive 2001/20/EC on the approximation of the laws, regulations and administrative provisions of the Member States relating to the implementation of good clinical practice in the conduct of clinical trials on medicinal products for human use [Internet]. 2001 Apr 4 [cited 2025 Sep 19]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32001L0020
27. Council of Europe. Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Oviedo Convention (ETS No. 164) [Internet]. 1997 Apr 4 [cited 2025 Sep 19]. Available from: https://www.coe.int/en/web/human-rights-and-biomedicine/oviedo-convention
28. World Medical Association. Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Participants [Internet]. [cited 2025 Mar 8]. Available from: https://www.wma.net/policies-post/wma-declaration-of-helsinki/
29. World Health Organization. WHO guidelines on ethical issues in public health surveillance. Geneva: World Health Organization; 2017. 66 p.
30. European Medicines Agency. Good clinical practice [Internet]. [cited 2025 Sep 19]. Available from: https://www.ema.europa.eu/en/human-regulatory-overview/research-development/compliance-research-development/good-clinical-practice
31. Ministry of Health of Ukraine. [On approval of the procedure for conducting clinical trials of medicinal products and examination of clinical trial materials and model regulation on ethics committees. Order dated 2009 Sep 23 No. 690] [Internet]. 2009 [cited 2025 Jul 9]. Available from: https://zakon.rada.gov.ua/laws/show/z1010-09#Text
32. Wąs M, Latała A, Zozula N, Rykucka A, Kiełbasa J, Kowalczyk A, et al. Treatment methods for varicose veins of the lower limbs. J Educ Health Sport. 2024;74:52561. https://dx.doi.org/10.12775/JEHS.2024.74.52561
33. Yun S. Clinical implications of venous hypertension in the management of chronic venous disease. Ann Phlebology. 2024;22(2):71-3. doi: 10.37923/phle.2024.22.2.71
34. Pugalenthi LS, Garapati C, Maddukuri S, Kanwal F, Kumar J, Asadimanesh N, et al. From data to decisions: AI in varicose veins – predicting, diagnosing, and guiding effective management. J Vasc Dis. 2025;4(2):19. doi: 10.3390/jvd4020019
35. Shrestha B, Karmacharya RM. Influence of body mass index (BMI), age and gender on stages of varicose vein in newly diagnosed cases following screening Doppler in outpatient clinic. Kathmandu Univ Med J. 2020; 18(69):28-31.
36. Hong K. The 2020 update of the CEAP classification: updated contents and background. Ann Phlebology. 2022;20:19-23. doi: 10.37923/phle.2022.20.1.1

37. Atamaniuk OY, Skrypko VD, Atamaniuk VM, Bybliuk YY. Relationship between ultrasonographic criteria, clinical manifestations and life quality parameters in patients with lower extremity varicose vein disease. World of Medicine and Biology. 2022;(2):13-8. doi: 10.26724/2079-8334-2022-2-80-13-18
38. Lahel RS, Chail AS, Kumar SM. Determination of cutoff diameter of great saphenous vein as indicative of saphenofemoral junction incompetence in cases of varicose veins. J Mar Med Soc. 2024;26(1):15-8. doi: 10.4103/jmms.jmms_173_22
39. Alghamdi DA, Al-Shehri RH, Al-Qahtani MF, Mehmood UA. The effect of varicose veins on the quality of life of adult female patients in the Eastern region of Saudi Arabia. Open Public Health J. 2020;13(1):771-8. doi: http://dx.doi.org/10.2174/1874944502013010771
40. Aslam MR, Asif HM, Ahmad K, Jabbar S, Hayee A, Sagheer MS, et al. Global impact and contributing factors in varicose vein disease development. SAGE Open Med. 2022;10:205031212211189. doi: 10.1177/20503121221118992
41. Santiago FR, Ulloa J, Regnier C, Peudon T, Braund E, Fradet-Aubignat C, et al. The impact of lower limb chronic venous disease on quality of life: patient and physician perspectives. J Comp Eff Res. 2022;11(11):787-801. doi: 10.2217/cer-2022-0054
42. Yang Q, Zhao Y, Chen X, Tang P, Li L, Zhao J, et al. Association between vein diameters, reflux characteristics, and clinical severity in patients with chronic venous insufficiency in Northwest China. J Vasc Surg Venous Lymphat Disord. 2021;9(2):401-408.e1. doi: 10.1016/j.jvsv.2020.07.006