

Ancheva I.A., Zubarenko K.O.¹, Movlyanova N.V., Gerasymenko O.A., Lazor N.V.,
Mokriienko E.M., Tiron O.I.¹

Odesa National Medical University, Odesa

¹International Academy of Ecology and Medicine, Kyiv

DIAGNOSTIC SIGNIFICANCE OF BRACHIOCEPHALIC AND TRANSCRANIAL VESSELS DUPLEX ULTRASOUND INVESTIGATION IN WOMEN DURING MENOPAUSE

e-mail: irina.ancheva555@gmail.com

The purpose of the study was to assess the effectiveness of ultrasound duplex scanning of the main vessels of the head and neck in women during menopause, with an analysis of clinical manifestations and anamnesis. The study included 105 patients aged 50–75 years who were not taking oral estrogens and statins. The diameters of the common and internal carotid, vertebral arteries were measured, as well as the assessment of the internal jugular veins. Registration included measuring the thickness of the intima-media complex and detecting atherosclerotic plaques. The blood flow velocity indicators of extracranial brachiocephalic vessels and paired cerebral arteries were evaluated. The results show that many patients have age-related changes in the vascular wall, plaques of varying echogenicity and localization, and decreased blood flow velocity. The study demonstrated high informativeness and accuracy in detecting structural and hemodynamic disorders. The obtained data confirm that regular ultrasound observations enable timely detection of subclinical vascular changes, assessment of their dynamics, and selection of individual strategies for the prevention and treatment of cardiovascular diseases. Authors resumed that ultrasound monitoring allows for the diagnosis of vascular system abnormalities, including echographic signs of both atherosclerotic angiopathy and atherosclerosis of the brachiocephalic arteries, with determination of the degree of stenosis and the fixation of the blood flow rate in the vessels.

Key words: ultrasound duplex scanning, menopause, carotid artery, carotid artery atherosclerosis, ultrasound monitoring.

Анчева І.А., Зубаренко К.О., Мовлянова Н.В., Герасименко О.А., Лазор Н.В.,
Мокрієнко Е.М., Тірон О.І.

ДІАГНОСТИЧНА ЗНАЧУЩІСТЬ ДУПЛЕКСНОЇ УЛЬТРАСОНОГРАФІЇ БРАХІОЦЕФАЛЬНИХ І ТРАНСКРАНІАЛЬНИХ СУДИН У ЖІНОК В ПЕРІОД МЕНОПАУЗИ

Метою дослідження була оцінка ефективності ультразвукового дуплексного сканування магістральних судин голови та шиї у жінок у період менопаузи з аналізом клінічних проявів та анамнезу. У дослідження було включено 105 пацієнок віком 50–75 років, які не приймали пероральні естрогени та статини. Проводилися вимірювання діаметрів загальних та внутрішніх сонних, хребетних артерій, а також оцінка внутрішніх яремних вен. Реєстрація включала товщину комплексу інтіма-медіа, виявлення атеросклеротичних бляшок. Оцінювалися швидкісні показники кровотоку екстракраніальних брахіоцефальних судин та у парних артеріях головного мозку. Результати свідчать, що у багатьох пацієнок спостерігаються вікові зміни судинної стінки, наявність бляшок різної ехогенності та локалізації, зниження швидкості кровотоку. Дослідження продемонструвало високу інформативність та точність виявлення структурних та гемодинамічних порушень. Отримані дані підтверджують, що регулярні ультразвукові спостереження дозволяють своєчасно виявити субклінічні судинні зміни, оцінювати їхню динаміку та вибирати індивідуальні стратегії профілактики та лікування серцево-судинних захворювань. Автори висловлюють, що ультразвуковий моніторинг дозволяє виявити аномалії судинної системи, діагностувати ехографічні ознаки атеросклеротичної ангіопатії та атеросклерозу брахіоцефальних артерій з визначенням ступеня стенозу та фіксацією швидкості кровотоку в досліджуваних судинах.

Ключові слова: ультразвукове дуплексне сканування, менопауза, сонна артерія, атеросклероз сонних артерій, ультразвуковий моніторинг.

Funding. The study is a fragment of the research project “The latest treatment, diagnostic and preventive approaches for diseases of the female reproductive system and high-risk pregnancy”, state registration No. 0122U201370.

A comprehensive assessment of blood vessels, both anatomical and functional characteristics, using ultrasound technology, is one of the key tools for women's health diagnosis, therapy planning, and monitoring at various stages of life [1, 8]. Duplex scanning with modern imaging sensors enables the detection of congenital and acquired vascular anomalies and the simultaneous imaging of vessels and blood flow spectra [11].

The visualization method provides an accurate definition of the vessel under study, an assessment of the structure of superficially located arteries, including measurement of the thickness of the intima-media complex (IMT) in the common carotid

artery (CCA), as well as the registration of blood flow parameters [5, 8]. Color Doppler mapping displays the direction and speed of blood flow using color coding. The combination of these modes within the framework of color duplex scanning (CDS) gives the method a leading role in the ultrasound diagnosis of the vascular system.

Ultrasound Doppler occupies a leading position in the non-invasive diagnosis of cardiovascular diseases and is widely used in areas such as angiology, cardiology, nephrology, and gynecology. Expanding the use of color Doppler significantly increases the accuracy of diagnosing hemodynamic disorders and expands the ability to detect vascular pathology, which

is of direct importance for comprehensive monitoring of a woman's health [11, 13].

With the onset of menopause, the risk of cardiovascular and cerebrovascular disorders increases; therefore, when assessing vascular function, it is important to consider age, menopausal status, hormonal background, and level of physical activity [9].

The European Society of Cardiology (ESC) published recommendations on the prevention of cardiovascular diseases (CVD) in clinical practice [12]. The recommendation emphasizes that CVD prevention based on individual assessment of general cardiovascular risk, risk factor modification, and the patient's active involvement is the priority in clinical practice. If it is impossible to perform a coronary artery calcium (CAC) scan, which is performed using computed tomography, the guide allows carotid artery ultrasound to detect atherosclerotic plaques and clarify the degree of risk. At the same time, the absence of plaques or carotid artery wall thickness changes is not considered an independent marker for deciding whether to initiate or discontinue therapy [12].

Special attention should be paid to women with a history of hypertensive disorders during pregnancy. There is subsequently a decrease in reserve coronary blood flow and changes in the structure of the myocardium in this group of patients, which significantly increases the likelihood of developing CVD, stroke, and metabolic disorders regardless of traditional risk factors [2]. In this regard, vascular ultrasound is an important tool for early detection of atherosclerotic changes.

Therefore, cardiovascular disease risk assessment is a mandatory procedure before prescribing hormone replacement therapy in women during menopause, while carotid artery ultrasound can be used to clarify individual risk assessment and align with the clinical recommendations of the North American Menopause Society and the International Menopause Society [14].

The purpose of the study was to evaluate the effectiveness of duplex ultrasound scanning of the main vessels of the head and neck in women during menopause, with an analysis of the anamnesis and clinical manifestations.

Materials and methods. The study was conducted in the multidisciplinary medical center "MEDICAP" (Odesa), which is one of the medical centers of the Odesa National Medical University during 2024–2025. The study included 105 female patients aged 50 to 75 years. The average age of the patients was equal to 60.4 ± 7.9 years.

The Commission of the Ethics of Odesa National Medical University (No. 09, 12, November, 2025) approved this clinical case research protocol with compliance. The investigation was conducted in compliance with the Declaration of Helsinki and subsequent additions.

Patients who did not take oral estrogens or statins participated in the study. All participants gave written informed consent before the start of clinical

observation, thereby allowing the use of the data obtained for scientific purposes.

Ultrasound is a safe method without absolute contraindications. However, the following relative limitations exist: open wounds, burns, dressings, or dermatological infections in the probe area, as well as significant intestinal gas, which interferes with the visualization of abdominal organs. There were no cases of patients' exclusion due to the abovementioned criteria in our study.

The study was conducted without special prior preparation, during 10.00–12.00 a.m. The examination room has a rectangular space measuring 16 m^2 , a constant temperature of $21 \pm 2 \text{ }^\circ\text{C}$, a humidity of 40–50 %, and approximately 150–180 lux illumination (up to 50 lux near the screen area to avoid glare). Air velocity in the room did not exceed 0.15 m/s.

The observation was performed in the patient's horizontal position, on her back, using an ultrasound device, "Toshiba Aplio 500" (Japan), with a linear sensor for visualization of the brachiocephalic vessels (frequency range 4.2–13.0 MHz). A sector-phased sensor and a specialized program for transcranial research with appropriate settings were used to study the vessels of the head.

In the B-mode, the CCA was scanned from both sides with measurement of vessel diameter and IMT. IMT was measured manually at the distal centimeter of the CCA (before the bifurcation), along the far wall, at the end of diastole (fig. 1).

Internal carotid arteries (ICA) and external carotid arteries (ECA), vertebral arteries (VA), and internal jugular veins (IJV) were also visualized and evaluated. Assessment of blood flow in the studied vessels was performed using pulsed Dopplerography and color Doppler mapping. The size and position of the control volume during spectral Doppler imaging of neck vessels were adjusted according to the vessel size (occupying at least $\frac{3}{4}$ of the vessel under study), and the Doppler angle was 60° . Transtemporal access was used for ultrasound of cerebral circulation. Velocity indicators of the blood flow in the vessels of the brain were evaluated: in the anterior cerebral artery (ACA), middle cerebral artery (ACM), posterior cerebral artery (ACP), main cerebral artery (AB) and in the Rosenthal vein.

Statistical processing of the obtained data was performed using Statistica 10.0 (StatSoft, Inc., USA).

Results of the study and their discussion.

Among the studied patients, the main complaints were headaches, pain in the back of the head in 69 patients (65.7 %), arterial hypertension or unstable blood pressure in 47 patients (44.8 %), dizziness in 13 patients (12.4 %), sleep disorders in 85 patients (81.0 %), tinnitus and vision disorders in 6 patients (5.7 %). The majority of patients (88 cases) also noted increased emotional tension and mood lability (83.8 %). Among endocrine disorders, type II diabetes was detected in 4 patients (3.8 %), obesity II–III degree in 27 patients (25.7 %).

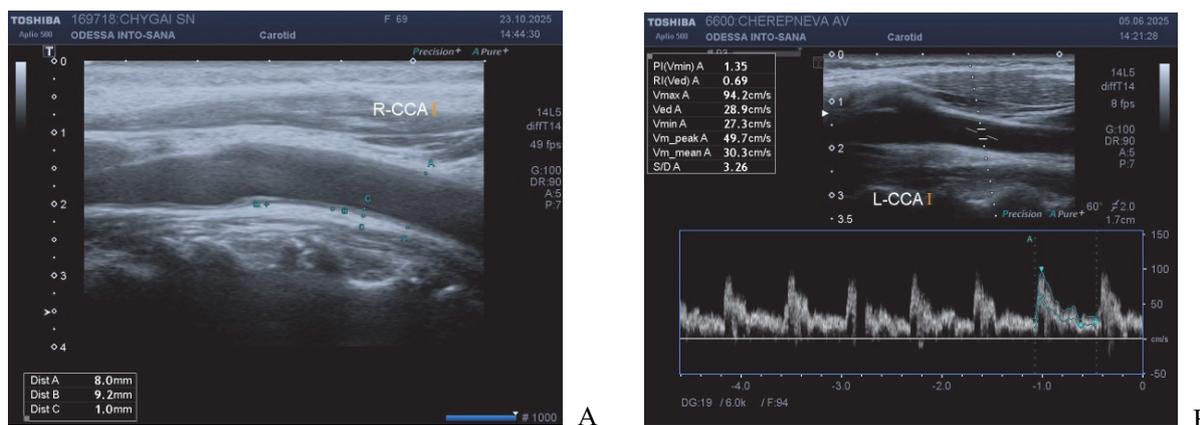


Fig. 1. Ultrasonographic images of the common carotid artery. A – Measurement of the diameter and intima-media thickness of the carotid artery in B mode; B – Measurement of blood flow velocity in the CCA.

According to the anamnesis data, 103 patients (98.1 %) had a history of pregnancy and childbirth. In 12 of them (11.7 %), the pregnancy occurred against the background of hypertensive disorders and preeclampsia. In addition, 69 women (65.7 %) included in the study experienced menopausal symptoms during menopause. 41 patients (39.0 %) used nicotine in the anamnesis, while 23 patients (22.0 %) continue to smoke.

According to the measurement data, the diameters of the CA, ICA, and ECA were 5.3 ± 1.1 mm, 4.7 ± 1.6 mm, and 4.2 ± 0.7 mm, respectively. In 62 patients (59.1 %), a decrease in the blood flow velocity in the ICA and CCA was registered. Peak systolic velocity of blood flow in the CCA averaged

56.3 ± 7.1 cm/s and 40.1 ± 6.7 cm/s in the ICA.

An increase in the peak systolic velocity of blood flow (>125 cm/s) was not registered in the ICA. Asymmetry of blood flow (not exceeding 30 %) in the ICA was registered in 7 patients (6.7 %). Signs of age-related changes in the vascular wall were visualized in 87 examined women (82.9 %). In 49 patients (46.7 %), thickening of the IMT and loss of the usual layered structure of the CCA wall were noted, and initial signs of atherosclerosis in the form of local thickening of the IMT of the carotid artery (more than 1 mm, but less than 1.5 mm) were detected in 23 patients (21.9 %). Local atherosclerotic plaques of varying echogenicity were found in 15 patients (14.3 %) (fig. 2).

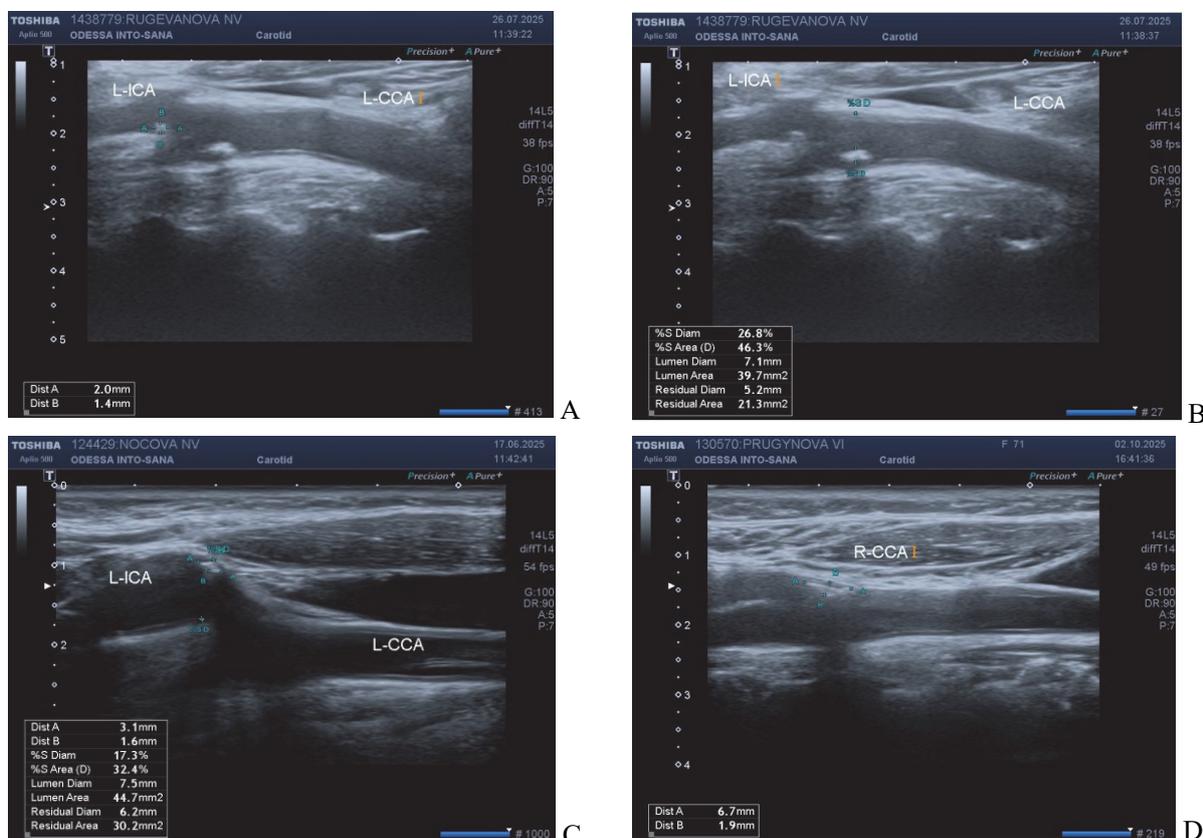


Fig. 2. Examples of B-mode ultrasonographic images of patients with atherosclerotic changes in the brachiocephalic arteries. A – Echogram of a patient with two atherosclerotic plaques in the CCA and ICA; B – Measurement of plaque size and degree of stenosis (measured by diameter in longitudinal section, ECST method); C – Hyperechoic atherosclerotic plaque along the anterior wall of the left ICA; D – Calcified atherosclerotic plaque with acoustic shadowing located at the bifurcation of the CCA.

The degree of the CCA narrowing, measured by the diameter in the longitudinal section according to the ECST (European Carotid Surgery Study) method, was less than 50 % and was estimated as hemodynamically insignificant. Vertebrogenic irregularity of the VA path was recorded in 23 patients (21.9 %). Small-diameter VAs were identified in 6 patients (5.7 %). The peak systolic velocity of blood flow along the VA was 24.5 ± 3.3 cm/s. A decrease in the linear velocity of blood flow in the VA was recorded in 37 patients (35.2 %), interlateral asymmetry of blood flow indicators in the VA was noted in 7 patients (6.7 %) and was estimated as

hemodynamically (more than 30 %) significant (fig. 3 A, B).

Ultrasound imaging of the IJV was also performed bilaterally, with assessment of the vessel lumen and blood flow, as well as wall compressibility. IJV phlebectasia was detected in 3 patients (2.9 %). During the examination of intracranial vessels, a decrease in blood flow velocity was revealed in ASA in 34 (32.4 %) patients, in ACM in 39 (37.1 %) patients, and in ACP in 47 (44.8 %) patients (fig. 3C, D). We note the presence of ultrasound-detected vascular pathology in a greater number of patients, as we identified two or more disorders in a single patient.

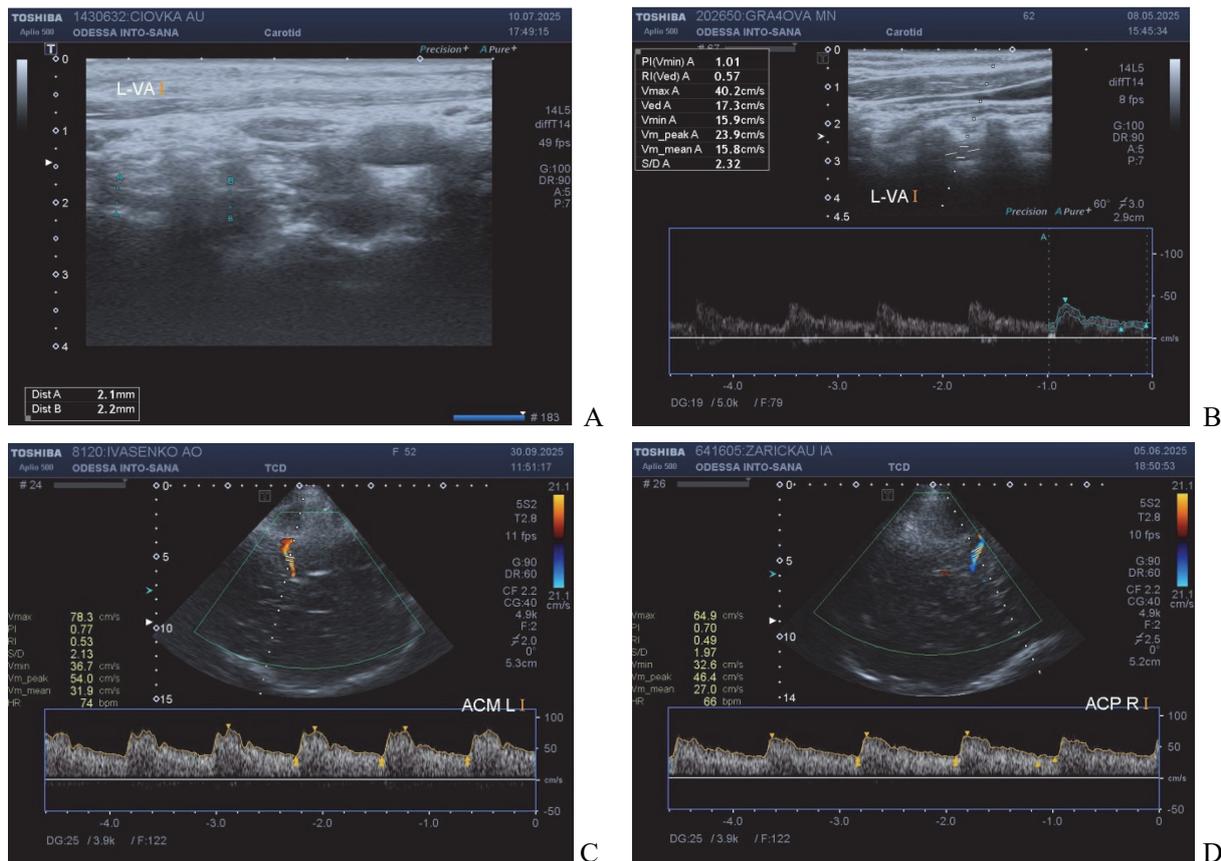


Fig. 3. Ultrasound examination of vertebral and intracranial arteries. A – Visualization of a small-diameter vertebral artery in B-mode; B – Spectral Doppler waveform of blood flow in the vertebral artery; C – Doppler spectrum of blood flow in the middle cerebral artery; D – Doppler spectrum of blood flow in the posterior cerebral artery.

Vertebrobasilar insufficiency was registered in 58 patients (55.2 %). At the same time, asymmetry in blood flow velocity indicators between paired brain arteries was observed in 42 patients (40.0 %). In 37 patients (35.2 %), an increase in the velocity of blood flow in the Rosenthal vein was observed, indicating impaired venous outflow from the cranial cavity.

Thus, the results indicate the high informativeness of ultrasound examinations of the brachiocephalic and transcranial blood vessels in women during menopause. This method allows not only the identification of abnormalities of the vascular system, early signs of structural changes in the vascular wall, and hemodynamic disorders, but also the assessment of their severity. In our opinion,

regular ultrasound monitoring of blood vessels in women in this category contributes to the timely identification of the initial manifestations of vascular pathology and to the selection of optimal treatment and prevention strategies in each specific case.

To discuss the obtained data, we will focus on the following.

Taking into account the physiological features of the female reproductive system, every woman experiences the decline of the reproductive function of the body and the onset of menopause. During this period, the probability of CVD and cerebrovascular disorders increases. This is due to a decrease in estrogen levels, which weakens their protective effects on the cardiovascular system, including

maintaining vascular wall elasticity and tone, regulating lipid and carbohydrate metabolism, and supporting antioxidant mechanisms, leading to impaired blood supply. Atherosclerosis of carotid arteries is one of the main pathological causes of CVD, especially in postmenopausal women. [7, 15].

Atherosclerotic lesions of the carotid arteries play a leading role in the pathogenesis of cardiovascular diseases, especially in women after menopause, when a decrease in estrogen levels contributes to their progression [6]. Assessment of carotid artery IMT is important for predicting the development of CVD and can be used for personalized cardiovascular risk assessment in women with risk factors or during menopause. Women who experience vasomotor and other symptoms of menopause, as well as those who have an unfavorable lipid profile, insulin resistance, vitamin and trace element deficiencies, an increased risk of hypertension, or bad habits, have a higher risk of developing coronary heart disease and stroke [3, 4].

In these conditions, an increase in the IMT reliably correlates with an increase in cardiovascular

risk in menopausal women, which makes this research method a valuable tool for an individual approach to the prevention and management of patients. Regular ultrasound imaging of the carotid arteries in menopausal women enables timely detection of subclinical changes in the vascular wall, such as IMT thickening and atherosclerotic plaque formation [5, 8]. In addition, women experiencing hot flashes and other menopausal symptoms have decreased vasodilation and increased aortic calcification, regardless of estradiol levels and standard cardiovascular risk factors [1, 10]. The data we obtained are consistent with the results reported in the scientific literature.

Limitations. We used the following restrictions when clinically examining women in the menopausal period: women with an early menopause under the age of 40, women over the age of 75, women with a history of estrogen and statin use, women with menopause and a history of concomitant cancer, and women with menopause and a history of strokes were excluded from the patient sample.

Conclusions

1. Ultrasound examination of extracranial vessels is a non-invasive, highly informative, objective, and specific method for detecting structural and hemodynamic changes in women during menopause.

2. In the presence of risk factors for cardiovascular diseases and accompanying complaints of female patients, it is recommended to use ultrasound for in-depth screening with the aim of early detection of signs of adverse vascular changes and assessment of their dynamics.

3. Ultrasound monitoring allows for the revelation of abnormalities of the vascular system, to diagnose echographic signs of atherosclerotic angiopathy and atherosclerosis of brachiocephalic arteries, with determination of the degree of stenosis and fixation of the blood flow rate in the vessels under investigation. During studies of paired brain arteries, changes in blood flow speed and asymmetry, as well as cerebral venous dyscirculation, were observed.

Prospects for further research include the continuation of such ultrasound examinations of key vessels in females at menopausal age to search for, develop, and introduce into daily practice adequate and earliest ultrasound markers of possible cardiovascular complications.

References

1. El Khoudary SR, Aggarwal B, Beckie TM, Hodis HN, Johnson AE, Langer RD. et al. Menopause transition and cardiovascular disease risk: implications for timing of early prevention: a Scientific Statement from the American Heart Association. *Circulation*. 2020; 142(25): 1713-1727. doi: 10.1161/CIR.0000000000000912.
2. Countouris ME, Catov JM, Zhu J, Jong N, Brands J, Chen X. et al. Association of Hypertensive Disorders of Pregnancy With Coronary Microvascular Dysfunction 8 to 10 Years After Delivery. *Cardiovascular Imaging*. 2024; 17(5): 016561. doi: 10.1161/CIRCIMAGING.124.016561.
3. Countouris ME, Villanueva FS, Berlacher KL, Cavalcante JL, Parks WT, Catov JM. Association of hypertensive disorders of pregnancy with left ventricular remodeling later in life. *J Am Coll Cardiol*. 2021; 77: 1057-1068. doi: 10.1016/j.jacc.2020.12.051.
4. Fasero M, Coronado PJ. Cardiovascular Disease Risk in Women with Menopause. *J Clin Med*. 2025; 14(11) 3 663. doi: 10.3390/jcm14113663.
5. Kalashnikov VY, Stoyanov OM, Vastyanov RS, Kugel YI, Andreeva TO. Features of Cerebral Hemodynamics and Cognitive Status in Patients with Chronic Ischemia of the Brain on the Background of Stenosing Atherosclerosis of the Brachiocephalic Arteries. *Ukrainian Journal of Cardiovascular Surgery*. 2025; 33(4): 113-120. doi: [https://doi.org/10.63181/ujcvs.2025.33\(4\).113-120](https://doi.org/10.63181/ujcvs.2025.33(4).113-120).
6. Lee GB, Nam GE, Kim W, Han B, Cho KH, Kim SM. et al. Association between premature menopause and cardiovascular diseases and all-cause mortality in Korean women. *J Am Heart Assoc*. 2023; 12(22): 030117. doi: 10.1161/jaha.123.030117.
7. Liu J, Zeng X, Ruan J, Kang Y, Lu Y, Li S. Development and validation of a predictive model for carotid atherosclerosis in postmenopausal women. *Sci Rep*. 2025; 11(15): 5079. doi: 10.1038/s41598-025-89098-7.
8. O'Brien MW, Kimmerly DS, Theou O. Sex-specific frailty and chronological age normative carotid artery intima-media thickness values using the Canadian longitudinal study of aging. *Vascular*. 2024; 32(3): 579-588. doi: 10.1177/17085381231157125.
9. Ruediger SL, Pizzey FK, Koep JL, Coombes JS, Askew CD, Bailey TG. Comparison of peripheral and cerebral vascular function between premenopausal, early and late postmenopausal females. *Exp Physiol*. 2023; 108(5): 518-530. doi: 10.1113/EP090813.
10. Saxena A, Kwee Ng EY, Lim ST. Imaging modalities to diagnose carotid artery stenosis: progress and prospect. *Biomed Eng Online*. 2019; 18: 66. doi: 10.1186/s12938-019-0685-7.
11. Tiron OI, Ancheva IA, Mokriienko EM, Movlyanova NV, Lazor NV, Vastyanov RS. Study of vascular access in haemodialysis patients using ultrasonography. *World of Medicine and Biology*. 2025; 2(92): 130-135. doi: 10.26724/2079-8334-2025-2-92-130-135.

12. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Back M. et al. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J.* 2021; 42(34) 3 227-3337. doi:10.1093/eurheartj/ehab484
13. Wang F, Jin P, Feng Y, Fu J, Wang P, Liu X. et al. Flexible Doppler ultrasound device for the monitoring of blood flow velocity. *Sci Adv.* 2021; 7(44): eabi9283. doi: 10.1126/sciadv.abi9283.
14. Xia R, Fan S, Jian H, Lei C, Wendan M, Chenxu W. et al. Effect of fasting glucose levels on carotid intima-media thickness in premenopausal versus postmenopausal women. *Arch Endocrinol Metab.* 2024; 15(68): 230110. doi: 10.20945/2359-4292-2023-0110.
15. Zhao M, Zhang N, Wang M, Li J, Liu Y, Li Y. et al. Transitions in metabolic health and onset age of cardiovascular diseases. *Am. J. Prev. Med.* 2023; 65(6): 1059–1068. doi: 10.1016/j.amepre.2023.06.002.

Conflict of interest. The authors have no conflicts of interest to declare.

ORCID: Ancheva I.A. <https://orcid.org/0000-0001-8213-1570>, Zubarenko K.O. <https://orcid.org/0009-0000-1083-7734>, Movlyanova N.V. <https://orcid.org/0000-0003-1733-2389>, Gerasymenko O.A. <https://orcid.org/0000-0003-1291-657X>, Lazor N.V. <https://orcid.org/0000-0001-5729-5071>, Mokriienko E.M. <https://orcid.org/0009-0001-1497-9606>, Tiron O.I. <https://orcid.org/0009-0000-5041-2538>.

Article received: 12.01.2025.

DOI 10.26724/2079-8334-2026-1-95-28-32

UDC 618.11-008.64; 616.728.3-007.17-073.7:618.173

Akhmedova Z.G., Khatamzade E.M., Babaeva G.G., Rustamova K.M.¹
Azerbaijan State Institute for Advanced Medical Studies named after A. Aliyev, Baku, Azerbaijan
¹Research Institute of Obstetrics and Gynecology, Baku, Azerbaijan

RESULTS OF A DENSITOMETRIC STUDY IN WOMEN WITH EARLY MENOPAUSE AND PREMATURE OVARIAN FAILURE

e-mail: med_avtor@mail.ru

The study included 50 women divided into two groups: early menopause (n=19) and premature ovarian insufficiency (n=31). A control group consisted of 20 women with preserved menstrual function. Serum estradiol, vitamin D, and ionized calcium were measured, and quantitative ultrasound densitometry was performed (SOS, BUA, BQI, T- and Z-scores). Correlation analysis was used to assess relationships between hormonal, metabolic, and densitometric parameters. Women with premature ovarian insufficiency demonstrated more pronounced bone mineral density reduction compared to those with early menopause. Estradiol levels showed a weak negative correlation with densitometric indices, whereas ionized calcium was positively correlated with BQI and T-score. Hypoestrogenism is a key factor in the reduction of bone mineral density in women with early menopause and premature ovarian insufficiency. A comprehensive assessment of hormonal and metabolic status, combined with densitometry, is essential for the early detection of osteopenia and the prevention of osteoporosis.

Key words: early menopause, premature ovarian insufficiency, estradiol, vitamin D, calcium, ultrasound densitometry, bone mineral density.

Ахмедова З.Г., Хатамзаде Е.М., Бабаєва Г.Г., Рустамова К.М.

РЕЗУЛЬТАТИ ДЕНСИТОМЕТРИЧНОГО ДОСЛІДЖЕННЯ У ЖІНОК З РАННЬОЮ МЕНОПАУЗОЮ ТА ПЕРЕДЧАСНОЮ ОВАРІАЛЬНОЮ НЕДОСТАТНІСТЮ

Було обстежено 50 жінок, розділених на дві групи: з ранньою менопаузою (n=19) та з передчасною оваріальною недостатністю (n=31). До контрольної групи увійшли 20 жінок із збереженою менструальною функцією. Визначали рівень естрадіолу, вітаміну D та іонізованого кальцію, а також проводили ультразвукову денситометрію (показники SOS, BUA, BQI, T- та Z-критерії). Виконано кореляційний аналіз взаємозв'язків між гормонально-метаболічними та денситометричними параметрами. У пацієнок з передчасною оваріальною недостатністю виявлено більш виражені зміни мінеральної щільності кісткової тканини порівняно з жінками з ранньою менопаузою. Рівень естрадіолу мав слабку негативну кореляцію з показниками денситометрії, тоді як іонізований кальцій – позитивний зв'язок із BQI та T-критерієм. Гіпоестрогенія є ключовим фактором зниження мінеральної щільності кісткової тканини у жінок з ранньою менопаузою та передчасною оваріальною недостатністю. Комплексна оцінка гормонального та метаболічного статусу у поєднанні з денситометрією необхідна для раннього виявлення остеопенічних змін та профілактики остеопорозу.

Ключові слова: рання менопауза, передчасна оваріальна недостатність, естрадіол, вітамін D, кальцій, ультразвукова денситометрія, мінеральна щільність кісток.

Funding. This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The study was conducted at the authors' primary place of work and was funded from their income there.

Early menopause and premature ovarian insufficiency (POI) are associated with many complications and problems in women. It is reported that early menopause, which occurs between the ages of 38 and 45, affects up to 12 % of women, and POI, in which loss of ovarian function

occurs before the age of 40, affects about 2–4 % of women [6].

Long-term health problems associated with early menopause and POI include an increase in cardiovascular diseases, cognitive impairment, an increased risk of autoimmune diseases, and a