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ELECTROMYOGRAPHIC EVALUATION OF MASTICATORY MUSCLES IN PATIENTS WITH UNILATERAL CROSSBITE AND LATERAL MANDIBULAR SHIFT

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Electromyography of masticatory muscles is informative and modern method of diagnostics in dentistry and in orthodontics particularly. Unilateral crossbite is associated with asymmetric activity of masticatory muscles. Electromyography was conducted in 20 patients with unilateral posterior crossbite with right side (9 patients) and left side (11 patients) mandibular shift in the period of the permanent dentition. The result of electromyography was a graphical representation and a digital characteristic of the contractility of the temporomandibular muscles. It was revealed association between unilateral posterior crossbite, chewing cycle and deviation in electromyography activity. The reducing of the masseter activity on the cross bite side and increasing on the non-cross bite side have been demonstrated.

Key words: electromyography, masticatory muscles, malocclusion.

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ЕЛЕКТРОМІОГРАФІЧНА ОЦІНКА ЖУВАЛЬНИХ М'ЯЗІВ У ПАЦІЄНТІВ З ОДНОБІЧНИМ ПЕРЕХРЕСНИМ ПРИКУСОМ ТА БІЧНИМ ЗМІЩЕННЯМ НИЖНЬОЇ ЩЕЛЕПИ

Електроміографія жувальних м'язів є інформативним і сучасним методом діагностики в стоматології та в ортодонтії зокрема. Односторонній перехресний прикус пов'язаний з асиметричною діяльністю жувальних м'язів. Електроміографія жувальних м'язів проведена 20 пацієнтам з одностороннім перехресним прикусом зі зміщенням нижньої щелепи в праву (9 пацієнтів) і ліву (11 пацієнтів) сторони у період постійного прикусу. Результатом електроміографії було графічне зображення та цифрова характеристика біоелектричної активності скроневих і жувальних м'язів. Виявлено зв'язок між одностороннім перехресним прикусом, циклом жування та відхиленням електроміографійної активності. Встановлено зниження жувальної активності на стороні перехресного прикусу та збільшення показників електроміографійної активності на протилежній стороні.

Ключові слова: електроміографія, жувальні м'язи, патологія прикусу

The work is a fragment of the research projects"Status of dental health and its correction on the basis of systematic analysis of clinical-laboratory, radiological, morphological, functional, aesthetic parameters in persons of different ages number" state registration No. 0120U002143, "Interdisciplinary approach to the diagnosis and treatment of patients with dental anomalies and deformities", state registration No. 00118U004343.

Electromyography (EMG) is an experimental investigative method of examination based on recording and analysis of myoelectric signal. According to dates of researches electromyography is the study of the electrical signal that muscles produce [3]. EMG is the technique for assessment and recording the electrical activity produced by muscles while they are in rest or activity [7,11].

In the past, orthodontists depended mainly on static and stable records in the form of cast models and head films analyzes for diagnosis and treatment planning. Since orthodontists have moved from a stable to a dynamic and functional concept of occlusion, it is mandatory that orthodontist should know how a muscle act, have knowledge of physiology of skeletal muscle contraction [9].

In Dentistry the potentials in actively contracting lingual and masticatory muscles can be studied. EMG also can be is used for identifying the results of the therapy, monitoring of bruxism and muscles tracking, evaluation of muscle asymmetries or possible postural disturbances and significant muscles weakness.

There are two types of EMG electrodes: surface electrode and inserted electrodes. Usually, surface EMG is used to assess muscle function by recording muscle activity from the skin surface over the muscle using a pair of electrodes. Surface EMG permits the noninvasive investigations of the bioelectrical phenomena of muscular contraction [6]. Surface EMG electrodes use a non-invasive approach for EMG signal measurement and detection. The current can flow into the electrode and theoretically behind it; between the skin and the detecting surface formation of chemical equilibrium takes place through electrolytic conduct. Advantages: simple and very easy to implement; surface EMG electrodes require no medical supervision and certification. Disadvantages: they are generally used for superficial muscles only; their position must be kept stable with the skin; otherwise, the signal is distorted.

EMG of masticatory muscles is informative and modern methods of diagnostics of TMG disorders, muscles and intra-capsular. EMG was conducted at stages of diagnostics (for evaluation of muscles activity) and treatment in patient with TMG disorders and confirmed effectiveness orthodontic treatment algorithm [14].

Posterior cross bite is defined as a malocclusion with the presence of one or more teeth of the posterior group (from canine to second molar) in an irregular (at least on cusp wide) bucco-gingival or bucco-palatal overlap [8]. Its prevalence in the primary and early mixed dentition is 8–22 % among orthodontic patients [1] and in 5–15 % among the general population [4]. Dental, skeletal, and neuromuscular factors can be recognized as possible etiological factors, but the most frequent cause of cross bite is reduction of the maxillary dental arch width. Even if spontaneous correction can occur [2], posterior crossbite, and especially unilateral posterior cross bite, can result mandibular shift. It has been suggested that an altered morphological relationship between the upper and lower dentition is associated to right-to-left-side differences in the condyle fossa relationship. The asymmetrical function in patients with posterior cross bite was reported to be associated to different development of the right and left sides of the mandible over time, asymmetric contraction of the masticatory muscles, thickness of the unilateral masseter muscle, and a different chewing pattern.

The purpose of the study was to investigate the association between posterior unilateral cross bite in patients (with right-side and left-side shift of the mandible) and EMG activity of masticatory muscles.

Material and methods. There were examined 20 patients (average age – 18.33±0.86 years) with unilateral posterior crossbite (ULPC) (11 patients with right-side shift and 9 patients with left-side shift) at Orthodontics Department of Danylo Halytsky Lviv National Medical University.

The electromyographic complex "Neuromyograph Synapsis", manufactured by the scientific and medical factory "Statokin", was used to measure the biopotentials of the masticatory muscles. The activity of the masticatory muscles was evaluated simultaneously from both sides. Before the electrodes were fixated, the areas of the greatest muscle tension were palpated.

EMG procedure. To obtain a good quality of EMG signal, impedance of the skin was reduced by removing the hair completely from the location where the electrodes were to be placed. In order to eliminate any wetness or sweat on the skin, the skin was cleaned with alcohol. The abrasive gel was used to reduce the dry layer of the skin. The surface EMG electrodes were positioned along the longitudinal midline of the muscle. The distance between the center of the electrodes and detecting surfaces was 1 cm. The longitudinal axis of the electrodes was parallel to the length of the muscle fibers during investigation.

In the study, electromyographic recordings of the biopotentials of the masseter and temporalis muscle were performed during general chewing, chewing on the right and left sides.

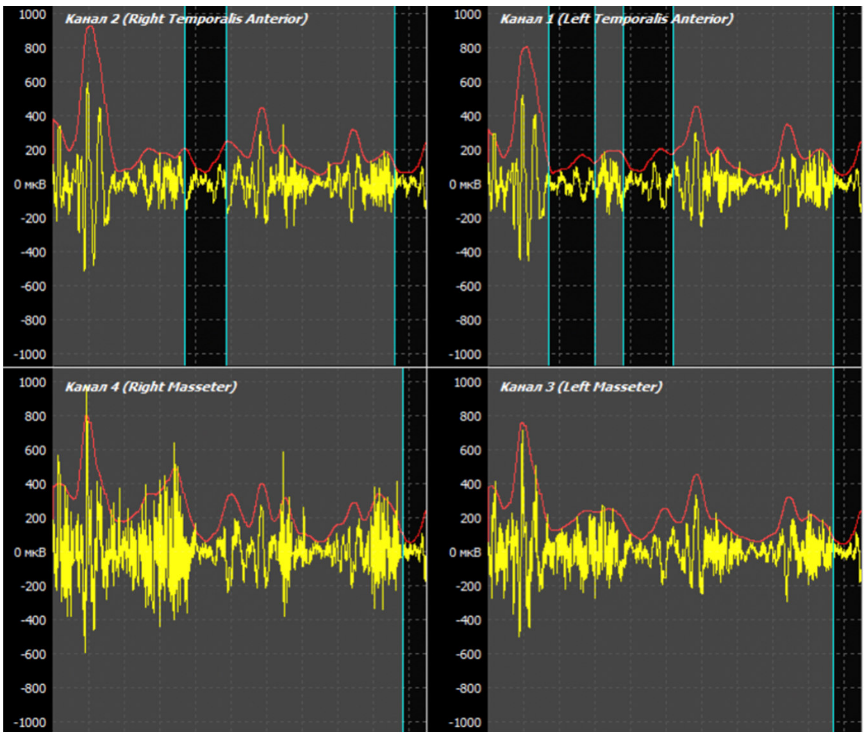

Fig. 1. Fragment of EMG during the general chewing cycle of the 12-years-old patient. Diagnosis: unilateral posterior cross bite

As the result of testing in the software it was carried out the calculation of the various parameters and filling in the tables based on them. The following parameters are displayed within these tables: LTA (left temporal anterior), RTA (right temporal anterior), LM (left masseter), RM (right masseter), A(max) – maximal amplitude of chewing (μV), A(aver) – mean amplitude of chewing (μV), S –mean means of chewing square (μV^*_{ms}).

The results of the surface EMG were presented as a graphical representation and a digital characteristic of the muscles contractility, which fully characterizes the bioelectrical activity.

Examination of patients was carried out taking into account the main provisions of the Helsinki Declaration on Biomedical Research (Seoul, 2008). Informed agreement of the patient to the examination was obtained.

Statistics 10.0 software was used for statistical data processing. For calculation of arithmetic meanings, their mistakes and probability of difference between them t-test for unpaired samples was used. Differences in meanings were considered statistically significant at p<0.05. Correlation dependences were measured using the Kendall-Tau correlation coefficient in the absence of a normal distribution.

Results of the study and their discussion. Examination of the general chewing cycle characteristics in patients with UPCB and right-side shift shows the absence of significant difference during general chewing (p>0.05) (fig. 1).

Table 1

EMG during general chewing cycle in patients with UPCB

Patients with right-side shift				Patients with left-side shift			
Muscle Areas	Valid N	Mean	Standard-Error	Muscle Areas	Valid N	Mean	Standard-Error
LTA A(max)	11	842.41	95.53	LTA A(max)	9	868.82	47.86
LTA A(aver)	11	234.93	21.27	LTA A(aver)	9	166.53	21.98
LTA S	11	333.04	46.59	LTA S	9	154.17	10.02
RTA A (max)	11	944.50	67.63	RTA A(max)	9	1310.04	181.86
RTA A(aver)	11	233,88	30.35	RTA A(aver)	9	267.11	72.01
RTA S	11	363.81	53.82	RTA S	9	317.14	85.80
LM A(max)	11	1084.57	135.06	LM A(max)	9	3189.57	774.89
LM A(aver)	11	442.16	115.84	LM A(aver)	9	364.29	23.14
LM S	11	591.60	193.39	LM S	9	283.15	30.70
RM A(max)	11	1128.52	174.04	RM A(max)	9	1231.96	131.15
RM A(aver)	11	463.53	144.91	RM A(aver)	9	249.60	38.55
RM S	11	619.78	237.20	RMS	9	265.16	52.45

Comparison of chewing muscles activities in patients with UPCB and left-side mandibular shift revealed a significant difference in 1.5 times between maximal amplitude of chewing of the left temporalis anterior and the right temporalis anterior muscles (868.82±47.86 μV vs 1310.04±181.86 μV, p<0.01); almost in 2.6 times (3189.57±774.89 μV vs 1231.96±131.15 μV) between maximal amplitude of the left masseter and the right masseter muscles; and in 1.5 times (364.29±23.14 μV vs 249.60±38.55 μV, p<0.05) between average amplitude of the left masseter and the right masseter muscles.

While comparing the dates of EMG examination of both groups of patients with crossbite (right-side and left-side shift) it was registered significant difference between maximal amplitude of chewing of left masseter muscles (1084.57±135.06 μV vs 3189.57±774.89 μV, p<0.01); average chewing square of left lateral temporal muscles (333.04±46.59 μV vs 154.17±10.02 μV, p<0.01); and average amplitude of chewing of left lateral temporal anterior muscles (234.93±21.27 μV vs 166.53±21.98μV, p<0.05), (Table 1).

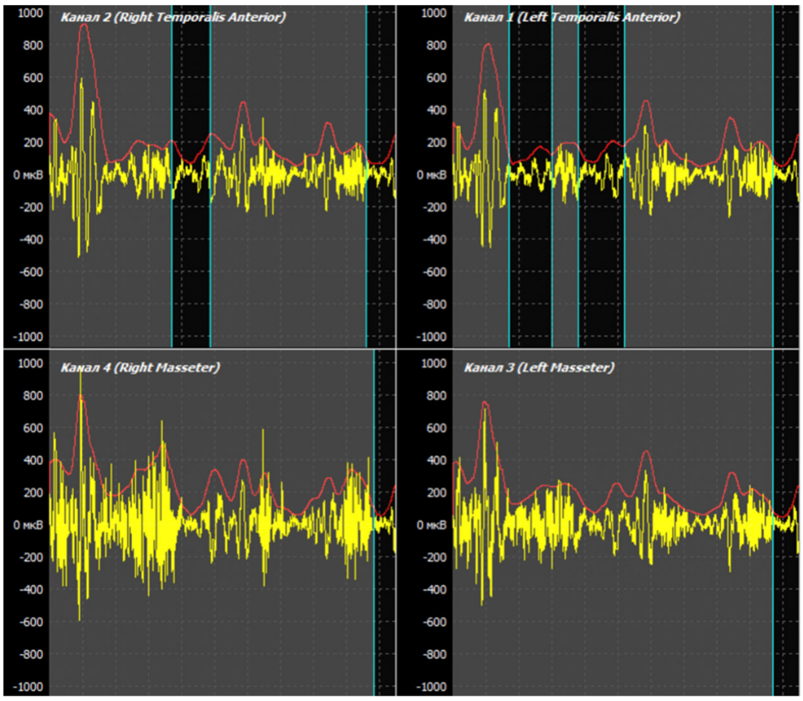

Fig. 2. Fragment of EMG during the right-side chewing cycle of the 12-years-old patient. Diagnosis: unilateral posterior crossbite

The obtained results of the EMG during evaluation of the right-side chewing cycle in patients with UPCB demonstrated any significant difference between all means during right-side chewing cycle (p>0.05), except difference by 3.2 times (450.13±144.64 μV vs 139.07±24.86 μV) between average mean of chewing square of left and right temporalis anterior muscles (p<0.05).

Comparison of chewing muscles activities during right-side chewing cycle (Fig.) in patients with UPCB and left-side shift revealed significant difference by 2.6 times (546.09±37.04 μV vs 1425.85±310.21 μV, p<0.05) between maximal amplitude of chewing of left temporalis anterior and right temporalis anterior and difference almost by 4 times (142.44±15.51 μV vs 555.15±154.48 μV, p<0.05) of the mean means of chewing square of the left and right temporalis anterior muscles (p<0.05).

There was difference by 2.5 times (170.04±28.56 μV vs 430.94±106.11 μV, p<0.05) while comparing both groups UPCB patients with right and left shift between average mean of chewing activity of the right temporalis muscles and between average mean of chewing square of right temporalis muscles (139.07±24.86 μV vs 555.15±154.48 μV, p<0.01) in both group.

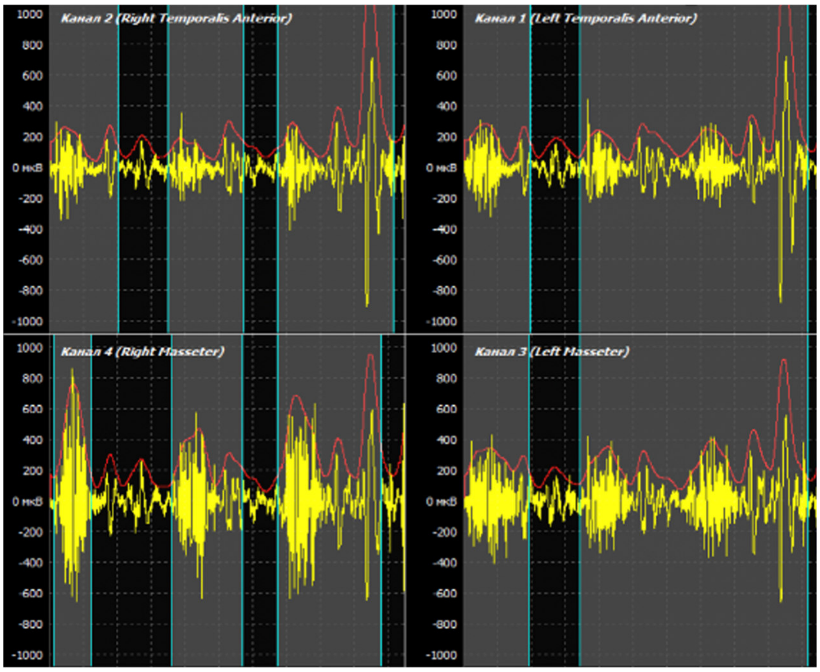

Fig. 3. EMG during left-side chewing of 12-years-old patients. Diagnosis: unilateral posterior crossbite.

There were no significant differences between activities of masticatory muscles in patients with right-side shift during left-side chewing cycle (p>0.05). While it was observed significant difference in patients with left-shift only between maximal amplitude of the right and left temporalis muscles by 1.6 times (699.82±6.48 μV vs 1106.70±264.77 μV, p<0.05). Comparison of left side chewing cycle of both group UPCB patients with right and left side shift shows only the significant difference by 3.3 times (97.89±18,73 μV vs 321.61±96.67 μV, p <0.05) between average means of chewing square of right temporal anterior muscles (fig. 3).

The comparison of EMG activities of the obtained data confirmed direct functional correlation in the patients with right-side shift between average left and right masseters activity, and in the patient with left-side shift between average left and right temporal activity (τ=1.00; p<0.001). It was also revealed indirect functional correlation between average activity of left and right masseters in the patient with left-side shift (τ=-1.00; p<0.001) (table 2).

Table 2.

Kendall Tau correlations in patients with the right side and left side shift during masticatory (chewing) cycles

Muscles area		Right side shift			Left side shift		
		General Mastication	Right side Mastication	Left side mastication	General mastication	Right side Mastication	Left side mastication
	N	11	11	11	9	9	9
LTA A(max) & RTA A(max)	T	0.99	1.00	1.00			1.00
	P	<0.001	<0.001	<0.001	>0.05	>0.05	<0.001
LTA A(aver) &RTA A(aver)	T	0.59	1.0	0.6	1.0	1.0	1.0
	P	<0.05	<0.001	<0.05	<0.001	<0.001	<0.001
LTA S & RTA S	T	0.99		1.00			
	P	<0.001	>0.05	<0.001	>0.05	>0.05	>0.05
LM A(max) &RMA(max)	T	0.57	1.00	1.00			1.00
	P	<0.05	<0.001	<0.001	<0.05	<0.05	<0.001
LM A(aver) &RM A(aver)	T	1.00	0.60	0.60	-1.00		-1.00
	P	<0.001	<0.05	<0.05	<0.001	<0.05	<0.001
LM S & RM S	T	0.59	0.60			1.00	
	P	<0.05	<0.05	>0.05	>0.05	<0.001	>0.05

EMG results in comparison during right-side chewing cycle in the patients with UPCB and right side deviation demonstrated a direct functional correlation between left and right temporalis maximal and average activity, also between left and right masseter maximal activity. The comparison of the EMG obtained data during right-side chewing cycle in the patients with left deviation showed direct functional correlation between left and right temporalis average activity and left and right average meanings of chewing square (τ= -1.00; p<0.001).

The date of comparison during left side chewing cycle in the patients with right side deviation revealed direct functional correlation between maximal activity of left and right temporalis muscles, left and right masseter muscles and left and right temporalis meanings of chewing square (τ=1.00; p<0.001). While comparing the muscles activities in the patients with left side shift showed direct functional correlation between maximal and average activity of left and right temporal muscles and between maximal activity of left and right masseter muscles (τ=1.00; p<0.001). There were indirect functional correlations between average activity of left and right masseter muscles (τ=-1.00; p<0.001).

Many studies have also determined the influence of the transversal malocclusions on the function of the masticatory muscles. Moreno et al. observed that the posterior crossbite resulted in a large decrease of masseter activity during a maximum effort test, thus most of the force was generated by the anterior temporalis muscle [10]. Another study showed that this malocclusion also affected mastication [12]. The percentage of reverse cycles when chewing was 59.0 % (soft bolus) and 69.7 % (hard bolus) for the affected side, and 16.7 % (soft bolus) and 16.7 % (hard bolus) for the non-affected one. Moreover, it was once more proved that masseter activity was reduced on the crossbite side and unaltered or increased on the non-affected side and it coincides with our research.

Slightly divergent results were presented by Tecco et al. [15]. The surface EMG activity for the masseter muscles between patients with crossbite and the control group was similar, suggesting that the occlusal alteration being investigated had no predictable effect on the activity pattern of these muscles. Nevertheless, they observed a significant difference in surface EMG activity for the anterior temporal muscle, which was higher at rest on the crossbite side. They also observed significantly lower activity in the sternocleidomastoid muscles during maximal volunteer's clenching in the control group compared to the group with transverse malocclusion.

According recently study it was revealed difference in amplitude mean between the malocclusion types on the crossbite sides and non-crossbite sides of the superficial masseter and temporal anterior muscles (p<0.05) [13]. This study confirmed there was a decrease in superficial masseter and anterior temporal muscle activity on the crossbite side rather than in the non-crossbite side in Angle's class I and class II. However, there was an increase in activity of the superficial masseter and anterior temporal muscles on the crossbite side for class III.

Analysis of the studies presented above confirms influence of malocclussion on the electrical activity of the masticatory muscles. Therefore, surface EMG extends the number of tools that are useful in the clinical diagnosis of sagittal as well transversal malocclusions.

Conclusion

1. Present investigation demonstrated significant difference between both group of the patients with unilateral posterior crossbite with right side and left side shifts of mandibular.

2. Unilateral cross bite with mandibular right or left shift is associated with asymmetric activity of masticatory muscle.

3. t was revealed association between posterior cross bite and chewing cycle and deviation in EMG activity, reduce of masseter activity on the cross bite side and unaltered or increased on the non-cross bite side.

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THE ROLE OF ENDOCRINE FACTORS AND HEAT SHOCK PROTEINS (HSP60 AND GROEL) IN PREDICTING THE EFFECTIVENESS OF TREATMENT OF CLIMACTERIC SYNDROME

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The research was carried out during the examination and treatment of 158 patients with the climacteric syndrome. The patients were divided into two groups: 1 group included 80 patients receiving menopausal hormone therapy; group 2 included 78 women who were not treated. All patients from two groups had their levels determined: anti-Müllerian hormone, follicle-stimulating hormone, luteinising hormone, and thyroid-stimulating hormone. In addition, a study of the level of antibodies (IgG) to human heat shock protein 60 (HSP60) and its bacterial homolog (GroEl) was conducted. As a result of the multivariate analysis, a reduction (p=0.012) of the risk of not achieving the effect of treatment due to symptoms of estrogen-deficiency state was found for treated patients, OR=0.29 (95 % CI 0.11–0.76) in comparison with the untreated group female patients (when standardised by the level of anti-Müllerian hormone). A higher (p=0.017) risk of not achieving the effect of treatment due to symptoms of an estrogen-deficient state revealed at a higher level of anti-Müllerian hormone, OR=6.1 (95 % CI 1.4–27) for every 1 ng/ml. Indicators of HSP60 and GroEl do not affect the effectiveness of treatment of clinical manifestations of estrogen deficiency.

Key words: perimenopause, climacteric syndrome, menopausal hormone therapy, HSP60.

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РОЛЬ ЕНДОКРИННИХ ФАКТОРІВ ТА БІЛКІВ ТЕПЛОВОГО ШОКУ (HSP60 ТА GROEL) У ПРОГНОЗУВАННІ ЕФЕКТИВНОСТІ ЛІКУВАННЯ КЛІМАКТЕРИЧНОГО СИНДРОМУ

Науково-дослідна робота проводилася при обстеженні та лікуванні 158 пацієнток з клімактеричним синдромом. Пацієнтки були розподілені на 2 групи: до 1 групи увійшло 80 пацієнток, які отримували менопаузальну гормональну терапію; до 2 групи увійшло 78 жінок, яким не проводилось лікування. Всім пацієнткам з двох груп проведено визначення рівнів: антимюлерового гормону, фолікулостимулюючого гормону, лютеїнізуючого гормону, тиреотропного гормону. Додатково проводилось дослідження рівня антитіл (IgG) до людського білку теплового шоку 60 (HSP60) та його бактеріального гомолога (GroEl). В результаті проведеного багатофакторного аналізу виявлено зниження (p=0,012) ризику не досягнення ефекту лікування за симптомами естроген-дефіцитного стану для пролікованих пацієнток, ВШ=0,29 (95 % ДІ 0,11–0,76) у порівнянні із групою не пролікованих пацієнток (при стандартизації за рівнем антимюлерового гормону). Виявлено вищий (p=0,017) ризик не досягнення ефекту лікування за симптомами естроген-дефіцитного стану при більш високому рівні антимюлерового гормону, ВШ=6,1 (95 % ДІ 1,4–27) на кожний 1 нг/мл. Показники HSP60 та GroEl, не впливають на ефективність лікування клінічних проявів дефіциту естрогенів.

Ключові слова: перименопауза, клімактеричний синдром, менопаузальна гормональна терапія, HSP60.

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Perimenopause is the process of the physiological transition of the female body from the reproductive stage to postmenopause. The perimenopausal transition includes several physiological changes that cause discomfort and affect a woman's quality of life. Changes during perimenopause lead to endocrine dysregulation of the reproductive system: the cycles become shorter and more sporadic, and the ovaries synthesise less estrogen and progesterone, which leads to disruption in the "ovary-pituitary-