

New Physical and Neurophysiological Rehabilitation Programmes for Women of Childbearing Age

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Abstract: *The article describes physical and neurophysiological rehabilitation of women of childbearing age with extragenital pathology, the most common oncologic pathologies of female genitalia. The article aims to develop a programme of physical and neurophysiological rehabilitation for women of childbearing age with extragenital pathology who underwent ovariectomy and evaluate its effectiveness. The authors observed 100 women aged between 18 and 45: the control group (CG) - 50 women and the experimental group (EG) - 50 women; each group was also divided into two age sub-groups - 18-29 years old and 30-45 years old. The exercise therapy included physical and neurostimulation rehabilitation measures: calisthenic routine, static and dynamic breathing exercises, shallow breathing, some elements of muscle relaxation and autogenic training, dosed walking inside the ward, going up the stairs, as well as dosed walking using treadmills, pelvic floor exercises. Methods of studying rehabilitation effectiveness are the following: instrumental methods (heart rate monitoring; arterial tonometry; respiratory rate measuring; spirometry); functional tests (hypoxic Stange and Genchi tests; orthostatic tests; clinostatic tests); laboratory research methods (clinical blood tests). The article proves that the employed methods of physical rehabilitation helped to increase indicators of the cardiovascular and respiratory systems in EG patients aged between 18 and 29 3-5 days earlier and EG patients aged between 30 and 45 - 3-4 days earlier than that in CG. It proves the effectiveness of the developed programme of physical rehabilitation for women of childbearing age with extragenital pathology who underwent ovariectomy.*

Keywords: *tumour diseases; female genital organs; shallow breathing; dosed walking; ovariectomy; oncologic pathology.*

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Introduction

Nowadays, tumours of the female genital tract are the most common among oncologic pathologies. Many scholars believe that ovarian tumours account for one-fourth of all female genital tract tumours (Bertelsen & Kruhoffer, 1995; Doll, 1998; Kulakov et al., 1998; Kulinich et al., 1999; Partridge et al., 1996; Savelyeva & Sichinawa, 1997; Vasileva, 1967). Cysts and ovarian cysts account for more than half of all benign neoplasms of the internal female reproductive organs (Smetnik, 1995; Smetnik & Tumilovich, 1998; Timoshenko et al., 1988). However, the clinical significance of such tumour diseases is confirmed not only by their prevalence but also by their attack rate among women of childbearing age, the development of severe complications (torsions, breakages) and their transition from benign to malignant neoplasms.

The main method of treatment of these diseases is surgery (including ovariectomy), which can lead to a profound restructuring of the functions of the female body and cause significant psychological trauma resulting in peritoneal adhesions, hormonal imbalance and pelvic organ prolapse due to weakening of pelvic floor and ligaments (Nelson & Felicio, 1986; Serov & Kudryavtseva, 1999). In the postsurgical period after ovarian cystectomy, patients can often experience certain disorders in the functions of the internal organs (the respiratory, cardiovascular, and urinary systems, the gastrointestinal tract).

The problem of physical and neurophysiological rehabilitation in gynaecology is still no less urgent or important. Given the present unfavourable ecological, economic, social, and psychological situation, gynaecological patients are prone to multimorbidity, that is the coexistence of two or more long-term medical conditions or diseases; reduced adaptive reactions to negative environmental impacts; emotional lability; nutrition imbalance, hypodynamia and, because of the latter two factors, excess body weight (Bogolyubov, 1998; Strugatskiy, 1981). In recent years, various means of physical rehabilitation (remedial physical training, massage, physiotherapy, phytotherapy) have been used to prevent postoperative complications after ovariectomy on the background of drug therapy (Mukhin, 2000). However, all available recommendations of specialists in physical rehabilitation are rather diverse. They suggest using such methods of exercise therapy and massage, which cannot eliminate and even prevent the above-mentioned changes in the body of women in the postoperative period. It must be noted that exercise therapy is prescribed without considering the psycho-emotional state of patients (women of childbearing age who underwent ovariectomy).

and concurrent diseases accompanying the main pathology. Physical rehabilitation is important to all patients who underwent gynaecological operations. Still, it is women who are at high risk for the occurrence of postoperative complications (in diseases of the respiratory, cardiovascular, and endocrine systems, fat metabolism disorders) who need it most (Bogolyubov, 1998; Kulakov et al., 1998; Vasilevskaya et al., 2002). However, the analysis of scientific literature shows no reference to the use of specially developed methods of exercise therapy and respiratory gymnastics in combination with other means of physical rehabilitation in the restorative treatment of women of childbearing age in the postoperative period after ovariectomy, considering the presence of extragenital pathology of the cardiorespiratory system and initial signs of obesity.

Different aspects of the problem under study are covered in the works of many scholars (Bakhmat et al., 2019; Behas et al., 2019; Bezliudnyi et al., 2019; Halaidiuk et al., 2018; Gerasymova et al., 2019; Maksymchuk et al., 2018; Melnyk et al., 2019; Nerubasska & Maksymchuk, 2020; Petrova, 2017; Sitovskiy et al., 2019; Sheremet et al., 2019).

Today, scholars tend to study the pathophysiology of cancer in several aspects: biological causes of cancer and neuropsychological phenomena associated with ontogenesis in cancer. Neurophysiological and neuropsychological causes and consequences of oncology are currently explored in terms of a) mechanisms induced by chemotherapy; b) clinical and treatment factors leading to cognitive deficits; c) changes and reactions of CNS to both disease and treatment (Armstrong, 2014). These data are constantly updated, and “other fields, such as cardiology, HIV, dementia and epilepsy, have been more successful in working with neuropsychological related to biomarkers for disease or diseased areas of the brain” (Armstrong, 2014). At the same time, psychological and neuropsychological publications on oncology have not reached such a level of development (Armstrong, 2014). This prioritizes research on physical and, especially, neurorehabilitation of post-oncological conditions.

In the broadest sense, cancer neuropsychology should provide answers to questions about quality of life, socialization, and psychosocial rehabilitation of cancer patients. Psychoneurological parameters of women who have survived breast cancer (especially those who have undergone chemotherapy) show that most of them manifest an obvious decline in neuropsychological functioning (Reid-Arndt, 2006).

The following issues remain open: a) the functional significance of post-oncological changes in neuropsychological functioning at work, social and gender roles; b) the main aetiology of the observed changes in cognitive

processes; c) the effects of neurorehabilitation for women who have survived cancer. These issues add relevance to the article, too.

Different types of oncological diseases cause different cognitive deficits. Therefore, it is essential to proceed from a specific aetiology and clinical practice when planning rehabilitation. Some researchers have already reviewed neuropsychology and its basic principles in correlation with cancer problems in women and men and predicted the potential aetiology of neurocognitive deficits depending on the nature of the cancer (Noggle & Dean, 2013). The neurocognitive consequences of brain cancer are now the most described.

One of the most important aspects of neurorehabilitation is the attempt to alleviate chronic or acute pain that often accompanies cancer. Such pain reduces self-esteem, interferes with daily activities, reduces productivity, and affects personal relationships. This requires one to develop personal scenarios of neurorehabilitation, improve the quality of clinical trials and a pragmatic approach to creating neurorehabilitation conditions.

The effectiveness of a multidisciplinary approach to neurorehabilitation relies on a combination of pharmacological treatments, physical and occupational therapy and psychological interventions tested in pain conditions, such as complex local pain, when single interventions are insufficient (Tamburin et al., 2017).

Adults' neurorehabilitation depends on the nature of the disease, as well as neurophysiological characteristics of the brain and CNS at this age. They determined that processes caused by age-related factors are morphological changes in brain areas, changes in neuronal morphology, changes in the network (including those in neuronal communication, neurogenesis and neurobiochemical changes. They also considered several aspects of neuroplasticity and discussed functional consequences of adults' neuroplastic capabilities and differentiated brain with reference to the history of their discovery (Fuchs & Flügge, 2014). More pathological neurophysiological changes occur when the age factor is subjected to stress or somatic (trauma) effects.

One should bear in mind that the post-oncological condition leads to chronic stress. The latter is a strong external stimulus that causes numerous neuroplastic changes. According to Fuchs & Flügge (2014), repeated or chronic stress changes the morphology of neurons in different areas of the brain. Probably, the most carefully studied neuromorphological change is the stress-induced regression of the geometric length of the apical dendrites of pyramidal neurons, which was first demonstrated in the hippocampus (Fuchs & Flügge, 2014). The hippocampus is part of the

limbic-HPA (hypothalamic-pituitary-adrenal) system and regulates the response to stress. Involvement of dendrites of pyramidal neurons has been repeatedly recorded after chronic stress, as well as after chronic administration of glucocorticoids. Thus, neurorehabilitation should be combined with the restoration of neurohormonal balance.

Brick & Skidmore (2020) analyzed the impact of cancer on a wider range of health problems, which determines the use of active rehabilitation. They claimed that neurorehabilitation is the activity of patients themselves, their timely visit to the centre and the acquisition of metacognitive and self-directed strategies for self-rehabilitation (Brick & Skidmore, 2020). Also, they argued that optimal cancer rehabilitation may consist in adopting and implementing activity-based rehabilitation approaches (Brick & Skidmore, 2020).

Recently, research on neurorehabilitology has focused on the restoration of sensorimotor deficits after damage to CNS. This requires physiological activation of the limb muscles, which can be achieved through functional exercises of hand / arm and leg movement and activation of the corresponding peripheral receptors (Gassert & Dietz, 2018). In this regard, neurorehabilitation is closely related to physical rehabilitation and exercise therapy. Given the post-oncological condition, both the implementation and restoration of any neurological function are rather limited. Thus, the restoration of sensorimotor function after surgery requires a combination of specialized engineering and neurophysiological knowledge.

The above-mentioned aspects prove the relevance of new physical and neurophysiological rehabilitation programmes for women of childbearing age with extragenital pathology who underwent ovariectomy to prevent postoperative disorders, complications and worsening of concurrent diseases of the respiratory and cardiovascular systems, considering cases of excess body weight.

The article aims to develop a programme of complex rehabilitation for women of childbearing age with extragenital pathology who underwent ovariectomy and evaluate its effectiveness.

Material and methods

Research methods include a theoretical analysis and a generalization of the literary data; a study of documentary materials (an analysis of medical records); questionnaires of patients (women of childbearing age who underwent ovariectomy); pedagogical methods (medical and pedagogical observations in the course of exercise therapy); anthropometric studies (height and weight measurement, chest excursion, abdominal wall excursion,

Kettle body mass index calculation); medical and biological methods (surveys, external examination, palpation, auscultation); instrumental methods (heart rate monitoring; arterial tonometry; respiratory rate measuring; spirometry); functional tests (hypoxic Stange and Genchi tests; orthostatic tests; clinostatic tests); laboratory research methods (clinical blood tests); methods of mathematical statistics.

The experiment consisted of four stages between 2015 and 2019. The first stage (2015) encompassed a study and an analysis of scientific and methodological literature to identify the coverage of the problem under study.

The second stage (2015-2016) involved developing an author's programme of physical rehabilitation for women of childbearing age after ovariectomy in the early and late postoperative periods (periods II and III), taking into account their progress, which included exercise therapy combined with shallow breathing, some elements of muscle relaxation, autogenic training, massage therapy, dosed walking and pelvic floor exercises. It also included identifying a contingent of patients.

The third stage (2016-2018) took place in the gynaecology department of Kharkiv Medical Academy of Postgraduate Education. The experimenters observed 100 women aged between 18 and 45 who underwent ovariectomy (ovarian cyst removal). They were divided into two groups: the control group (CG) – 50 women and the experimental group (EG) – 50 women; each group was also divided into two age sub-groups – 18-29 years old and 30-45 years old (according to the two reproductive periods – early and later). Their examinations were performed in the preoperative period (period I), the early postoperative period (period II) (on the 3rd-5th day after surgery) and before discharge from the hospital (period III) (on the 18th-20th day). All the women experienced approximately the same surgery: right- or left-sided total ovariectomy (72%), total ovariectomy (28%) (lower transverse incision). Also, upon admission to the hospital, the examined women showed signs of somatic extragenital diseases: chronic bronchitis with or without an asthmatic component (45%); vegetative-vascular dystonia (21%). It must be noted that 76.9% and 70.8% of EG women (18-29 and 30-45 years old) and 88.9% and 69.9% of CG women (18-29- and 30-45-year-old) suffered from excess body weight.

Based on the obtained results, the fourth stage (2018-2019) involved implementing the programme of physical and neurophysiological rehabilitation in rehabilitation treatment of gynaecology patients and professional training of specialists in physical rehabilitation.

The distinctive features of the proposed physical rehabilitation programme are the following:

1. The programme of physical and neurophysiological rehabilitation for EG women considered the changes in their health status, namely, concurrent pathologies in the respiratory and cardiovascular systems, which could lead to the worsening of their condition and certain complications in the early and later postoperative periods, as well as those changes that occurred after the surgery. The authors also considered the presence of excess body weight in the majority of EG women.

2. The exercise therapy included calisthenic routine, static and dynamic breathing exercises, shallow breathing, some elements of muscle relaxation and autogenic training, dosed walking inside the ward, going up the stairs, as well as dosed walking using treadmills, pelvic floor exercises. These exercises were applied sequentially, considering the course of the postoperative period, the day after the surgery and motor activity. The patients did not participate in the rehabilitation programme on the day when sutures were removed from a surgical incision. Physical and neurophysiological rehabilitation consisted of preoperative, early, and late postoperative periods and four motor activity modes (strict bed rest mode, bed rest mode, ward mode and free mode) (see Table 1).

3. The main forms of physical therapy in both groups are exercise therapy, morning exercise, individual physical exercise, and dosed walking. Training sessions were organized with the use of individual, small group, and group methods. A short version of the exercise therapy was applied in the period I to show the patients the moves which should be performed to the full extent after the surgery.

4. A combination of exercise and massage therapy was used to prevent postoperative complications in the cardiorespiratory system and the gastrointestinal tract. According to Yefimenko's method (2001), therapeutic massage was prescribed to EG patients from the first days after surgery. The abdominal massage was prescribed only from the 15th day after the surgery, that is, in the late postoperative period, when histological results were already available, and the benign nature of the ovarian cyst was confirmed.

Starting from the 15th day, it is necessary to do a differentiated abdominal classic massage (10-15 procedures) to prevent hernia. One should start from a moderate mode and gradually make it more intense on the background of exercise therapy aimed at strengthening abdominal muscles (first at the hospital; later, on an ambulatory basis).

Tab. 1. Description of rehabilitation periods and motor activity modes of EG patients

<i>Rehabilitation period, motor activity modes, the day before and after the surgery</i>	<i>Forms of training sessions</i>	<i>Means</i>	<i>Massage</i>
Preoperative period 1. <i>Bed rest</i> (2-3 days before the surgery)	morning exercise – 7-10 min exercise therapy – 15-20 min	1. Calisthenic routine. 2. Special physical and breathing exercises from the preparatory position, lying on one's back. 3. Shallow breathing, autogenic training and muscle relaxation.	Starting from the 2nd day of the early postoperative period, it is important to massage the patients' front of the chest and upper limbs in the supine position to redistribute blood circulation and strengthen the effect, which brings the arterial blood to the organs of the abdominal cavity and pelvis, as well as to prevent functional disorders of the cardiovascular and respiratory systems.
Early postoperative period 1. <i>Strict bed rest</i> (the 1st-2nd day after the surgery)	morning exercise – 7-10 min 2 times per day individual physical exercise – 5-7 min	1. Dynamic breathing exercises; coughing. 2. Exercises for distal and proximal parts of upper and lower limbs.	Chest massage is allocated 6-8 minutes and upper limbs massage – 7-8 minutes for each.
2. <i>Bed rest</i> (the 2nd-3rd day)	morning exercise – 7-10 min exercise therapy – 20 min individual physical exercise – 10-12 min	1. Dynamic breathing exercises. 2. Exercises for distal and proximal parts of upper and lower limbs. 1. Static and dynamic breathing exercises (chest breathing). 2. Exercises for distal and proximal parts of upper and lower limbs. 3. Pelvic floor exercises. 4. Household exercises. 5. Those exercises that gradually prepare patients for sitting, standing and walking.	

Late postoperative period <i>1. Ward mode</i> (the 3rd-6th day)	morning exercise – 10-12 min	1. Calisthenic routine. 2. Static and dynamic breathing exercises (chest and diaphragmatic breathing). 3. Exercises for distal and proximal parts of upper and lower limbs. 4. Walking on the spot (1-2 min, slowly) and inside the ward (1-2 min, slowly).	Starting from the 3rd-4th day, it is essential to do a segmental-reflex massage of paravertebral zones of the cerebrospinal segments S ₅ –D ₁ to prevent stagnation in the pelvis, as well as to further stimulate the function of the cardiovascular and respiratory systems (5-6 min).
	exercise therapy – 25 min	1. Shallow breathing with some elements of muscle relaxation and autogenic training. 2. Walking on the spot (1-5 min, slowly) 3. Dynamic breathing exercises. 4. Calisthenic routine.	
	individual physical exercise – 20 min	1. Calisthenic routine. 2. Static and dynamic breathing exercises. 3. Exercises for distal and proximal parts of upper and lower limbs. 4. Shallow breathing with some elements of muscle relaxation and autogenic training. 5. Walking on the spot (1-2 min, slowly) and inside the ward (1-2 min, slowly).	
<i>2. Free mode</i> (the 6th-8th – 18th-21st day)	morning exercise – 15 min	1. Calisthenic routine. 2. Static and dynamic breathing exercises. 3. Exercises for distal and proximal parts of upper and lower limbs. 4. Pelvic floor exercises. 5. Walking inside the ward (3-4 min, first slowly and then faster).	Starting from the 15th day, it is necessary to do a differentiated abdominal classic massage (10-15 procedures) to prevent hernia. One should start from a moderate mode and

	exercise therapy – 30 min	1. Shallow breathing with some elements of muscle relaxation and autogenic training. 2. Walking on a treadmill (5-10 min, first slowly and then faster). 3. Dynamic breathing exercises. 4. Calisthenic routine.	gradually make it more intense on the background of exercise therapy aimed at strengthening abdominal muscles (first at the hospital; later, on an ambulatory basis).
	individual physical exercise – 25 min	1. Calisthenic routine. 2. Static and dynamic breathing exercises. 3. Shallow breathing with some elements of muscle relaxation and autogenic training. 4. Walking inside the gynaecology department (3-5 min, slowly). 5. Walking up and down the stairs (1-2 flights of stairs: first, 1 stair in 2 sec; then, 1 stair in 1 sec).	

Source: Author's own conception

CG patients follow the standard programme, which has been used by local gynaecological departments. It also includes breathing exercises and Calisthenic routine, dosed walking inside the ward and the department. According to Kunichev's method (1985), massage should be prescribed starting from the 1st- 2nd day after the surgery (abdominal massage – starting from the 6th-8th day). The duration and the number of training sessions within exercise therapy per day were the same in both groups.

The general condition of patients was monitored based on surveys, heart rate monitoring, arterial tonometry, respiratory rate measurement, external signs of fatigue at the beginning and the end of training sessions, as well as during them.

Results

The indicators of the functional status of the women's body systems under study in the preoperative period and the first days after ovariectomy.

The data obtained from examinations of the women's functional status in the preoperative period indicate certain homogeneity of CG and EG patients within one age group. Most women suffer from excess body weight in (body mass index (BMI) ranged from 25.0 to 29.9). The patients' anamnesis included a chronic pathology of the respiratory and cardiovascular systems in approximately the same percentage of cases. CG and EG patients had equally reduced values of vital capacity, insufficient resistance to hypoxia, decreased chest, and abdominal wall excursion. The indicators of clinical blood tests were not significantly different, being at the level of physiological norms for women.

In both groups, the patients were characterized by approximately the same state of autonomic innervation (certain prevalence of sympathicotonia or parasympathicotonia). Only 5% of CG women and only 4% of EG women aged between 18 and 29 showed signs of eutonia. In CG, only 3% of patients aged between 30 and 45 showed such signs; in EG – only 4% of women. The analysis of the conducted survey based on the health-activity-mood (HAM) method proves that almost all women experienced a significant deterioration of the psycho-emotional state in the preoperative period, which can be explained either by the fear of future surgery or the impact of its consequences on further life, work capacity or the fear of terminated or disturbed reproductive function.

In the early postoperative period, the patients could also observe some body changes like those described in the analysis of literary sources: autonomic dysfunction, deterioration of the parameters of the cardiorespiratory system, signs of asthenic syndrome, anaemia, initial symptoms of post ovariectomy syndrome.

Regardless of their age, CG and EG patients showed some significant disorders in the body system under study. The disorders in the cardiovascular system included tachycardia (EG: 18-29 years old – up to 91.69 ± 1.48 beats per min ($p < 0.00001$), 30-45 years old – up to 95.00 ± 1.40 beats per minute ($p < 0.00001$); CG: 18-29 years old – up to 89.78 ± 0.98 beats per minute, $p < 0.00001$); 30-45 years old – 91.63 ± 1.26 beats per minute ($p < 0.00001$)), certain increase in diastolic blood pressure (CG: 30-45 years old – from 72.82 ± 1.77 mm Hg to 78.48 ± 2.05 mm Hg ($p < 0.05$)), a less frequent decrease in pulse blood pressure (EG: 18-29 years old – from 41.92 ± 1.37 to 37.50 ± 1.08 mm Hg ($p < 0.05$); CG: 18-29 years old – from 42.93 ± 0.82 mm Hg to 40.04 ± 0.87 mm Hg ($p < 0.05$)), which proves certain disorders in cardiac function economization at rest, its lack of recovery during diastole, an insufficient amount of blood entering the aorta

during left ventricular systole, associated with impaired hemodynamic processes after ovariectomy and a decrease in circulating blood volume, which is confirmed by postoperative anaemia based on the indicators of clinical blood tests (a decreased number of erythrocytes ($p < 0.00001$) and haemoglobin in EG: 18-29 years old – from $127.27 \pm 1.29 \text{ m}^* \text{l}^{-1}$ to $111.40 \pm 0.65 \text{ g}^* \text{l}^{-1}$, $p < 0.00001$), 30-45 years old – from $126.83 \pm 1.21 \text{ m}^* \text{l}^{-1}$ to $111.54 \pm 0.75 \text{ m}^* \text{l}^{-1}$ ($p < 0.00001$); in CG: 18-29 years old – from $126.84 \pm 1.08 \text{ m}^* \text{l}^{-1}$ to $111.70 \pm 0.64 \text{ m}^* \text{l}^{-1}$ ($p < 0.00001$), 30-45 years old – from $126.35 \pm 1.29 \text{ m}^* \text{l}^{-1}$ to $111.78 \pm 0.94 \text{ m}^* \text{l}^{-1}$ ($p < 0.00001$)).

In the early postoperative period, patients of both groups, regardless of their age, experienced short breath (EG – 18-29 years old – from 20.42 ± 0.49 to 25.50 ± 0.49 breaths per minute ($p < 0.00001$), 30-45 years old – from 20.83 ± 0.35 to 25.28 ± 0.58 breaths per minute ($p < 0.00001$); CG: 18-29 years old – from 20.92 ± 0.42 to 26.03 ± 0.36 breaths per minute ($p < 0.00001$), 30-45 years old – from 20.17 ± 0.43 to 25.09 ± 0.53 breaths per minute ($p < 0.00001$)), as well as hypoxia, impaired bronchial patency, a decrease in respiratory volume due to a decrease in chest excursion in EG following the painful syndrome in the area of surgery. It was rather dangerous for patients with extragenital pathologies (mainly, of the respiratory and cardiovascular systems) and could lead to bronchopulmonary disease recurrence or worsen the general condition of patients. It is indirectly confirmed by the data of clinical blood tests, which indicated leucocytosis and acceleration of the erythrocyte sedimentation rate. It must be noted that the early postoperative period is characterized by a decrease in the number of patients with excess body weight in all groups, which can be associated with a psychological trauma because of ovariectomy and significant blood loss.

After the surgery, the examination of the autonomic nervous system of almost all the women indicates the prevalence of sympathicotonia, rarely parasympathicotonia and seldom eutonia. The psycho-emotional state of the patients in the early postoperative period was slightly different in view of the patients' age, although it was mostly negative. Those women aged between 18-29 years showed a certain decrease in the indicators characterizing their health, activity, and mood. The women aged between 30 and 45 experienced certain deterioration in the condition, including a slight increase in activity and mood. However, almost all women experienced despair, sadness, fatigue, apathy, moodiness, exhaustion, weakness, attention deficit.

All this has proved the need of a targeted influence on the functions of the relevant systems of the body, reduced or altered after ovariectomy, by

exercise therapy, massage, dosed walking, breathing exercises, muscle relaxation, autogenic training, which have become the basis of the author's programme of physical rehabilitation for EG patients.

The dynamics of the indicators of the functional status of the women's body systems under study after ovariectomy. The analysis of relevant studies shows that the late postoperative period is characterized by a significant improvement in the parameters reduced or altered after ovariectomy caused by the regular and gradual inclusion of exercise therapy and massage in the process of restorative treatment. The number of EG patients of both age with normal body mass index has somewhat increased (18-29 years old – in 50.0% of patients; 30-45 years old – the number of the women with excess body weight has decreased by 8.3%). In CG, the experiments could observe the same indicators or those approximated to the preoperative period.

Also, there was some positive dynamics in the function of the cardiorespiratory system: EG and CG women managed to restore the normal response of the pulse to graduated exercise and economize cardiac function at rest. The same positive changes took place in the respiratory function. However, EG patients of both age sub-groups experienced certain improvements in the respiratory system compared to both the early postoperative and preoperative periods. Regardless of their age, patients of both groups recovered from postoperative anaemia and inflammatory processes (leucocytosis, acceleration of erythrocyte sedimentation rate).

Medical and pedagogical examinations were aimed at studying pulse response to dosed physical exercise. In the late postoperative period, EG and CG patients experienced a significant decrease in the percentage of pulse increase per one training session of exercise therapy ($p < 0.00001$) compared to the early postoperative period. It indicates that the patients gradually adapt their cardiovascular system to physical exercise (see Table 2). In the late postoperative period, the pulse recovery after physical exercise has also significantly accelerated ($p < 0.00001$).

The state of the autonomic nervous system has improved towards eutonia in many patients. Concerning EG patients of younger age, the percentage of women with eutonia has increased significantly (46%). The number of women with sympathicotonia has decreased by 1.7 times and the number of women with parasympathicotonia – by 1.9 times. In EG, the number of patients with eutonia aged between 30 and 45 has increased up to 48% in the late postoperative period. The number of women with sympathicotonia has decreased by 1.6 times, and the number of women with parasympathicotonia – by 2.3 times. In CG, the number of women with

eutonia aged between 18 and 29 has increased only up to 29% in the late postoperative period. The number of women with sympathicotonia has decreased by 9%, and the number of women with parasympathicotonia – by 16%. In CG, the number of women with eutonia aged between 30 and 45 has increased by 26% compared to the early postoperative period. The number of women with sympathicotonia has decreased by 16%, and the number of women with parasympathicotonia – by 10%

Tab. 2. The dynamics of heart rate monitoring during medical and pedagogical examinations in EG and CG patients (a response to one training session of exercise therapy)

No	Indicator	Period II	Period III	t	p
		x±m	x±m		
EG – 18-29 years old (n=26)					
1	% cardiac acceleration	45.35±0.47	18.62±0.45	41.12	<0.00001
2	cardiac restitution, sec	251.96±11.33	116.00±1.95	11.84	<0.00001
EG – 30-45 years old (n=24)					
1	% cardiac acceleration	45.96±0.51	18.96±0.63	33.33	<0.00001
2	cardiac restitution, sec	256.13±15.08	123.46±1.00	8.78	<0.00001
CG – 18-29 years old (n=27)					
1.	% cardiac acceleration	45.41±0.39	26.96±0.54	27.54	<0.00001
2.	cardiac restitution, sec	247.44±10.10	144.44±1.11	10.14	<0.00001
CG – 30-45 years old (n=23)					
1.	% cardiac acceleration	47.13±0,36	24.78±0.29	48.59	<0.00001
2.	cardiac restitution, sec	249.09±14,02	144.22±1.10	7.46	<0.00001

Source: Author's own conception

The psycho-emotional state of the patients (health-activity-mood) has improved, too ($p < 0.00001$). However, these positive shifts were more significant for the patients aged 18 and 29 years than for those aged between 30 and 45.

Despite the difference between physical rehabilitation programmes, similar positive dynamics in impaired or reduced functions of the body was observed in both CG and EG patients in the late postoperative period. It proves that the author's methodology of exercise therapy, included in the programme of physical rehabilitation, has not caused negative changes in the body of the women after ovariectomy. Indeed, it is more effective since it

has managed to normalize disorders in the body of the patients and significantly improve their condition compared with the preoperative period.

A comparative analysis on the indicators of the functional status of EG and CG women's body systems under study after ovariectomy shows that, regardless of their age, the same number of women suffered from excess body weight in the early postoperative period. In the late postoperative period, half of the women of younger age and more than a third of the women of older age had normal body weight, which was not characteristic of CG, where virtually all body mass indices returned to preoperative levels.

A comparative analysis of the indicators of the cardiovascular system shows that all the EG patients have shown a significant decrease in heart rate (within age limits) in the late postoperative period. The response of this indicator to physical activity was also more adequate in EG patients, given a faster recovery of the pulse after exercise therapy.

A comparison of respiratory function indicators in EG patients of both age groups in the late postoperative period proves that their respiratory system is more economical and effective than that in CG patients, which is proved by lower respiratory rate (in CG, they did not meet the physiological norm), higher vital capacity values, chest and abdominal wall excursion, significantly greater resistance to hypoxia and pronounced improvement of bronchial patency.

A comparison of dynamics in the examined indicators of clinical blood tests shows that EG patients of both age groups in the late postoperative period had significantly higher values of erythrocytes and haemoglobin, significantly lower values of leukocytes and erythrocyte sedimentation rate than CG patients. In this case, the values of these indicators of clinical blood tests in EG and CG patients before discharge from the hospital were within the physiological norms for women.

The data obtained from a comparison of the dynamics in the autonomic nervous system in EG and CG patients indicate that, before discharge from the hospital, eutonia was predominant in EG patients, whereas sympathicotonia was characteristic of CG patients.

The results of the surveys based on the health-activity-mood (HAM) method conclude that a percentage of EG women aged between 18 and 29 with positive characteristics of health-activity-mood parameters, as well as the total value of the HAM indicator, is higher than that in CG during the late postoperative period.

During medical and pedagogical examinations, the experimenters have determined the duration of disorders in the women's cardiorespiratory

system. The analysis of the obtained results shows that EG patients aged between 18 and 29 recovered from disorders in the cardiovascular and respiratory systems 3-5 days earlier than CG patients of the same age. Concerning the patients aged between 30 and 45, it took them more time to recover from disorders in the cardiorespiratory system. However, it must be noted that EG patients of this age recovered from disorders in the cardiovascular and respiratory systems earlier than CG patients (on average, 3-4 days earlier).

Therefore, the author's programme of physical rehabilitation is more effective and takes precedence in physical rehabilitation of women of childbirth age with concurrent pathologies (mainly, of the respiratory and cardiovascular systems) and excess body weight over conventional methods used for CG women.

Discussion

Most researchers believe that exercise therapy and massage should be prescribed in the pre- and postoperative periods to prevent postoperative complications, recurrence of the disease and eliminate functional disorders caused by the main pathological process. Such a combination helps to restore the basic mechanisms of regulation of impaired functions in the body of women after ovariectomy due to the use of tonic, trophic, compensatory, and normalizing actions of physical exercises. Many specialists in physical and neurophysiological rehabilitation single out three periods in the prescription of exercise therapy and massage to hospital patients after gynaecological surgeries with the goals, tasks, ways and forms of training sessions and methods of exercise therapy meeting them. Given the fact that the examined women who underwent ovariectomy showed a high percentage of concurrent extragenital pathologies (of the respiratory and cardiovascular systems, excess body weight), the available methods of exercise therapy for patients with such pathologies were studied. Therefore, the authors of this paper can conclude that the available techniques of breathing exercises and dosed walking contain the elements unacceptable for hospital patients with extragenital pathologies who underwent ovariectomy. The simplest breathing exercises recommended for use by most authors in the postoperative period may not always be able to prevent the recrudescence of concurrent pathologies of the respiratory and other body systems. The above-mentioned facts have caused the need to develop a new programme of physical rehabilitation to suit the condition of gynaecological patients, as well as to verify the effectiveness of the developed and applied methods of exercise therapy and massage by comparing them with

conventional methods of exercise therapy and massage included in the programme of physical rehabilitation and those used in gynaecological departments based on the restorative dynamics of impaired functions of the women's body systems affected during the principal and concurrent diseases and after ovariectomy.

The scientific value of the obtained results is as follows:

- for the first time, a complex programme of physical and neurophysiological rehabilitation which takes into account pathological changes occurring in the body of women after ovariectomy, a stage and nature of the course of the postoperative period, concurrent extragenital pathologies and includes exercise therapy with some elements of dosed walking (on treadmills) and massage therapy has been developed;
- theoretical knowledge about the impact of the proposed methods of physical and neurophysiological rehabilitation on the cardiovascular, respiratory and autonomic nervous systems at the inpatient stage of remedial treatment based on the evaluation of their effectiveness have been supplemented;
- the data on a negative character of women's psycho-emotional state before ovariectomy and in the early postoperative period and its positive dynamics after the use of the proposed rehabilitation methods have been expanded.

The paper confirms the obtained results about the need to prescribe rehabilitation in remedial treatment of women after ovariectomy, taking into account the extent of surgical intervention and the following changes in the women's body, as well as the periodization of the course of the postoperative period. It also proves the data on the role of exercise therapy and massage therapy in the restoration of impaired functions of the women's body after ovariectomy.

Also, the paper supplements and expands the existing limited data on the need to consider concurrent extragenital pathologies when prescribing physical rehabilitation to patients who underwent ovariectomy (Vasilevskaya et al., 2002), as well as on the psycho-emotional state of women after such surgery. It supplements the data on the dynamics of the postoperative period arising under the influence of the author's programme of physical and neurophysiological rehabilitation.

The article presents indirect evidence for a new concept of neurorehabilitation from CNS diseases. Neurooncological rehabilitation refers to assistance to those who have become disabled due to a tumour (or therapy) to improve symptoms and maximize functional independence, activity (e.g., walking) and participation (e.g., employment, reintegration into

social and household life), within constant depreciation (Bartolo & Zucchella, 2019). Those women who have undergone gynaecological operations tend to suffer from the inferiority complex, including self-depreciation and distancing from a full life.

Post-oncology patients experience a decline in quality of life due to the difficulty reintegrating into everyday life, habitual family, and social roles, as well as into the role of a person with special needs (Bartolo & Zucchella, 2019). After any surgical intervention, physical rehabilitation should be followed by neurorehabilitation due to reduced mobility, cognitive and psychological problems of postoperative patients.

The article can serve as a source of data for initial neurophysiological studies on rehabilitation effectiveness. Kaupp et al. (2018) assume that after 5 weeks of physical rehabilitation one should assess the neurophysiological effect: a) regarding changes in limb strength (bilaterally) with the help of maximum voluntary isometric contractions of legs and arms; b) regarding changes in the inter-abdominal connection by modulating skin reflexes with electric current; links between lower limbs by fixing the enhanced modulation of the amplitudes of the stretching reflex. Such methods may be valid in assessing the effect of women's rehabilitation after genital tumour removal.

The new data involve developing the programme of physical rehabilitation which includes exercise therapy with some elements of shallow breathing, muscle relaxation, autogenic training and dosed walking (on treadmills) in combination with massage therapy, taking into account the pathological changes affecting the women's body after ovariectomy, a stage and nature of the course of the postoperative period, types of concurrent extragenital pathologies and further confirmation of its effectiveness. The examination of such gynaecological patients in the preoperative, early, and late postoperative periods shows that EG women who participated in the author's programme of physical rehabilitation show more positive results obtained when studying the dynamics of their general condition, weight and height parameters, functions of the cardiovascular and autonomic nervous systems, clinical blood tests and psycho-emotional status, which is confirmed by mathematical processing of the obtained data.

Conclusions

The analysis of scientific literature shows that most researchers consider special physical rehabilitation as a compulsory final component of any surgical treatment of pelvic organs required for full recovery and restoration of gynaecological patients' reproductive functions. The leading

role in this process belongs to exercise and massage therapy. The impact of these physical and neurophysiological rehabilitation methods on the women's body after ovariectomy solves the main task, that is the prevention of postoperative complications, relapse and recrudescence of concurrent somatic pathologies and the elimination of functional disorders caused by the principal pathological process. The existing techniques of breathing exercises and dosed walking contain the elements unacceptable for hospital patients with extragenital pathologies who underwent ovariectomy. The simplest breathing exercises recommended for use by most authors in the postoperative period may not always be able to prevent the recrudescence of concurrent pathologies of the respiratory and other body systems. The women of childbirth age with concurrent extragenital pathologies who underwent ovariectomy usually experience a symptom complex in the form of a painful syndrome, some signs of vegetative distress and psychasthenic condition, as well as certain hyperplasia of a healthy ovary, which may occur in the first days of weeks after the surgery.

The obtained data show no significant differences in all defined parameters of functions of the cardiovascular and respiratory systems when comparing the values of indicators in EG and CG women of two age groups in the preoperative period. Both EG and CG patients showed equally decreased values of vital capacity, insufficient resistance to hypoxia, decreased chest and abdominal wall excursion, ineffective airway clearance. Normal body weight was characteristic of only 23.1% of EG women and 11.1% of CG women aged between 18 and 29 years, as well as 29.2% of EG women and 30.1% of CG women aged between 30 and 45. Sympathicotonia and parasympathicotonia were observed in approximately the same percentage of cases. Eutonia occurred only in 3-5% of the patients. The general psycho-emotional state of almost all the women was negative.

The early postoperative period was characterized by autonomic dysfunction, certain deterioration of functions of the cardiorespiratory system, asthenic syndrome, anaemia, early post ovariectomy syndrome, tachycardia ($p < 0.00001$), shortness of breath ($p < 0.00001$), instability of blood pressure indicators, decreased chest and abdominal wall excursion ($p < 0.00001$), decreased resistance to hypoxia ($p < 0.00001$), significantly decreased bronchial patency, decreased vital capacity, the prevalence of sympathicotonia (compared with the preoperative period). It must be noted that the number of cases of eutonia has decreased by two-four times. According to the health-activity-mood test, the general psycho-emotional state remained negative.

Based on the obtained results, the programme of physical and neurophysiological rehabilitation for EG women has been developed taking into account concurrent pathologies of the respiratory and cardiovascular systems, excess body weight. It includes exercise therapy with some elements of the calisthenic routine, static and dynamic breathing exercises, shallow breathing, muscle relaxation and autogenic training, dosed walking inside the ward and gynaecological department, going up and down the stairs, dosed walking using treadmills, pelvic floor exercises and massage therapy.

A comparative analysis of the examined indicators of the patients' certain body systems shows that in the late postoperative period, half of the women of younger age and more than a third of the women of older age had normal body weight, which was not characteristic of CG, where virtually all body mass indices returned to preoperative levels. Before discharge from the hospital, the cardiovascular and respiratory systems of EG patients worked more economically and effectively than those of CG patients, which can be proved by lower respiratory rate (in CG, they did not meet the physiological norm), higher vital capacity values, chest and abdominal wall excursion, significantly greater resistance to hypoxia and pronounced improvement of bronchial patency.

In the late postoperative period, eutonia (46%) was predominant in EG and sympathicotonia (40%) – in CG. A higher percentage of women aged between 18 and 29 with positive characteristics of health-activity-mood parameters, as well as a higher total value of the HAM indicator, was characteristic of EG (18-29 years old – $p < 0.00001$; 30-45 years old – $p < 0.0001$).

The employed methods of physical rehabilitation helped to increase indicators of the cardiovascular and respiratory systems in EG patients aged between 18 and 29 3-5 days earlier and in EG patients aged between 30 and 45 3-4 days earlier than in CG. It proves the effectiveness of the developed programme of physical rehabilitation for women of childbearing age with extragenital pathology who underwent ovariectomy.

The conducted research on the effectiveness of the developed and applied physical and neurophysiological rehabilitation programme for EG patients who underwent ovariectomy can be confirmed by the obtained data, has a significant advantage over conventional methods and open new prospects for effective treatment and recovery of such patients.

The practical value of the obtained results lies in developing and implementing the programme of physical rehabilitation which includes exercise and massage therapy in remedial treatment of women with

concurrent extragenital pathologies after ovariectomy, which has made it possible to shorten the duration of hospital treatment by 3-5 days that is of great importance. Besides, the obtained data can be used during exercise therapy in specialized gynaecological departments in the pre- and postoperative periods, in the professional activity of specialists in physical rehabilitation in women's health clinics, where those patients who underwent ovariectomy undergo further rehabilitation and are under supervision, and professional training of specialists in physical rehabilitation in higher education institutions, namely, within the framework of the course of physical rehabilitation in gynaecology.

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