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THE IMPACT OF THERAPY AND REHABILITATION ON COGNITIVE FUNCTIONS IN PATIENTS AFTER TRAUMATIC BRAIN INJURY

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Abstract. The effectiveness of an individual physical therapy program in children with the consequences of traumatic brain injury (TBI) was analyzed. According to statistics, only 50–60% of patients after inpatient treatment fully recover or have minimal neurological disorders. In 63–75% of children who have suffered TBI, a delay in physical and mental development is observed. Mild TBI, as a rule, passes without complications, but in approximately 3% of cases, a sudden deterioration of the condition is possible, which requires timely detection to prevent the development of serious neurological dysfunctions.

Purpose of the research: to analyze the dynamics of cognitive function indicators in children after TBI at the inpatient rehabilitation stage.

Materials and methods of the research. The study was conducted on the basis of the Faculty of Medicine of the Lesya Ukrainka Volyn National University and the Volyn Regional Territorial Medical Association for the Protection of Motherhood and Childhood. The study involved 10 children aged 8–17 years who had suffered TBI. All patients and their parents were informed about the study conditions and provided informed consent to participate. Medical history analysis, somatic and neurological examination were performed. Comprehensive rehabilitation with the use of physical therapy was carried out in inpatient conditions during the subacute stage of recovery. The Montreal Cognitive Assessment (MoCA) scale, the Clock Drawing test, and the Rancho Los Amigos Scale were used to assess effectiveness.

Results. Analysis of the results showed a statistically significant improvement in cognitive functions in patients after a comprehensive therapy and rehabilitation program, in particular in the areas of memory, attention, and executive functions. According to the results of the assessment of cognitive functions according to the Montreal scale (MoCA), the average value at the end of the study was 24.2 ± 1.78 , which confirms a statistically significant improvement ($p < 0.001$). The Clock Drawing Test showed a mean score of 6.7 ± 0.45 with significant progress compared to baseline ($p < 0.001$). A comprehensive assessment of cognitive-behavioral functions using the Rancho Los Amigos scale showed improvement in all patients.

Conclusions. Despite modern advances in neurosurgery and intensive care, TBI remains one of the leading causes of mortality and disability in the world. About a third of patients die in the prehospital stage, and another 20–30% in the hospital.

Successful rehabilitation is based on the principles of evidence-based medicine, in particular, maintaining adequate brain perfusion, norm ventilation, prevention of hypoxemia, hypercapnia and intracranial hypertension. At the same time, an important component is secondary prevention of complications such as hyperthermia, hyponatremia, hyperglycemia and impaired water-salt balance.

A comprehensive physical therapy program for children with TBI should be individual, flexible and dynamic, adapted to the functional state of the patient and the dynamics of his recovery. Its structure includes elements of physical activity, cognitive therapy, speech and social-psychological interventions. The proposed weekly program demonstrated effectiveness in restoring not only motor but also cognitive functions of children, which was confirmed by the results of standardized tests - the Montreal Cognitive Assessment Scale, the Clock Drawing Test and the Rancho Los Amigos Scale.

The study confirmed the importance of a comprehensive approach in the rehabilitation of children with TBI, which includes physical therapy as the main component of restoring cognitive functions.

Keywords: physical therapy, traumatic brain injury, cognitive impairment, rehabilitation, MoCA, Clock Drawing Test.

Introduction. Traumatic injuries of the skull and brain - traumatic brain injury (TBI) - one of the most pressing issues of modern medicine, which is a complex multidisciplinary problem, characterized by high mortal-

ity and frequent disability of victims, including children, which leads to serious consequences with persistent and temporary loss of working capacity, significant economic costs for the family and society, which are associated with the implementation of medical and rehabilitation measures [5].

TBI is unique, as it often leads to changes in personality and behavior without changing the appearance of the victim [19].

The term TBI appeared in the 1930s–1940s, replacing the term «cranial trauma» [20]. According to modern views, TBI is considered one of the most deadly and debilitating conditions in the world, affecting people of all ages, including children [9], requiring a multidisciplinary approach at the national level by specialists in the field of health, economics, and sociology [20].

TBI ranks first in terms of mortality [11]. TBI is the third leading cause of death after cardiovascular and cancer diseases. [5]. TBI is the most common cause of death and disability in victims with combined trauma (multisystem injury). Among patients with combined trauma, 40% are diagnosed with damage to the central nervous system (CNS) [18].

Research rationale. Physical therapy for children with TBI is based on an integrated approach that combines motor, cognitive, and sensorimotor techniques. This approach promotes the simultaneous restoration of physical and cognitive functions, improves the child's adaptation to everyday life.

The diagnosis of TBI is based on the clinical picture and is confirmed using diagnostic methods [4]. To objectify the existing neurological syndromes after a TBI, include: assessment of post-traumatic CSF disorders, cerebral arachnoiditis, post-traumatic epilepsy, vestibular and cognitive disorders [17]. In the structure of craniocerebral injuries, the leading place is occupied by its mild severity, which includes concussion and mild brain contusion [10].

More than 41% of patients with mild TBI have a progressive course, which is combined with a longer trauma history, more severe neurological deficit, lower level of cognitive functioning and higher level of depression [15].

The purpose of the research: to analyze the dynamics of cognitive function indicators in children after traumatic brain injury at the inpatient rehabilitation stage.

Materials and organization of the research. The study was conducted at the Faculty of Medicine of the Lesya Ukrainka Volyn National University. The physical therapy program was implemented in inpatient conditions at the subacute stage of rehabilitation on the basis of the KP «Volyn Regional Territorial Medical Association for the Protection of Motherhood and Childhood». The study was carried out in accordance with the principles of the Declaration of Helsinki. All patients and their parents (relatives) who were involved in the study were familiarized with the study and gave their consent to participate. Medical histories were studied, and initial and final examinations of patients who participated in the study were conducted. 10 children aged 8-17 years who had suffered TBI participated in the study.

To assess the cognitive functions of patients, the Montreal Cognitive Assessment Scale (MoCA), the clock drawing test, and the Rancho Los Amigos Scale were used.

Montreal Cognitive Assessment (MCA) [1, 3] - Montreal Cognitive Assessment Scale - the most widely used test for detecting cognitive problems and assessing cognitive aspects: attention and concentration, executive function, memory, language, visual-constructive skills, abstract thinking, ability to count and navigate. The maximum possible result is 30 points; 26 points and above are considered the norm.

The «Clock Drawing» test is recommended for determining memory disorders. It is necessary to offer the patient to draw a round clock with numbers on the dial. Then, within three seconds, the patient must draw «fifteen to two». In the presence of cognitive disorders, memory problems, the patient makes inaccuracies and errors. The test result is evaluated on a 10-point scale: 10 points - the norm, the circle is drawn, the numbers are in the right places, the arrows show the specified time; 9 points - minor inaccuracies in the location of the hands; 8 points - errors in the location of the hands are more noticeable (one of the hands deviates by more than an hour); 7 points - both hands show the wrong time; 6 points - the hands do not show the time (the time is circled); 5 points - incorrect location of the numbers on the dial (the numbers are in reverse order, i.e. counterclockwise, or the distance between them is unequal); 4 points - the integrity of the clock is lost, some of the numbers are missing or located outside the circle; 3 points - the dial and the numbers are no longer connected to each other; 2 points - the patient makes attempts to complete the task, but unsuccessfully; 1 point - the patient makes no attempts to follow the instructions. Data interpretation: a result of less than 9 points - the presence of pronounced memory impairment.

The Rancho Los Amigos Level of Cognitive Functioning Scale [16] is a 10-point descriptive scale of cognitive functioning used to assess cognitive and behavioral functions in patients with TBI. It takes into account the patient's state of consciousness and the level of assistance the patient requires to perform cognitive and physical functions. The study used mathematical statistical methods for a variational series whose distribution does not differ from the normal one with the calculation of generally accepted indicators.

Research results and their discussion. Rehabilitation of patients with TBI, prediction of clinical and social consequences, secondary prevention of complications are the competence of specialists of a multidisciplinary team: neurosurgeons, neurologists, psychiatrists, psychologists, traumatologists, intensive care physicians, general practitioners, rehabilitation specialists and other clinicians [5].

Studies [7] have shown that among victims of TBI of varying severity, about 30% of victims die at the pre-hospital stage, and among hospitalized patients, 20-30% die in the hospital, another 10-20% suffer from permanent disability. Only 50-60% of patients who have undergone inpatient treatment fully recover or minimal neurological symptoms and disorders remain.

In 63–75% of children who have suffered TBI, there is a delay in physical and mental development [12].

Most patients with mild TBI recover without complications. Approximately 3% experience a sudden deterioration in their condition, which can potentially lead to serious neurological dysfunctions if a decrease in mental activity is not detected in time [13].

The results of treatment of patients with TBI are determined by the timeliness of medical care at the prehospital stage, as well as timely hospitalization in specialized neurosurgical departments [11], and timely comprehensive rehabilitation.

Rehabilitation as a system of measures aimed at restoring impaired cognitive functions and adapting patients to further life and socialization is one of the important points in the neurological clinic [6]. According to the authors [14], rehabilitation is one of the main methods of therapy in neurology. In the realities of Ukrainian medicine, rehabilitation of neurological patients is underdeveloped. In contrast, clinics in European countries focus on long-term, effective rehabilitation in neurological departments aimed at restoring motor, speech, and cognitive deficits. In case of TBI, medical care should be provided based on the provisions of evidence-based medicine, which have proven effectiveness, namely, to ensure the maintenance of adequate cerebral perfusion, normoventilation, and adequate oxygenation. Prevention of hypoxemia, hypercapnia, arterial hypotension, and intracranial hypertension reduces the risk of death, helps prevent the development of secondary complications, and significantly improves the results of treatment and rehabilitation [8]. Other complications that need to be prevented include hyperthermia, hyponatremia, hyperglycemia, and fluid imbalance in the body [4].

The physical therapy program should be comprehensive, individually selected taking into account the child's condition and capabilities. It should be constantly adjusted depending on the dynamics of his condition, taking into account physical capabilities at each stage of rehabilitation.

The complex of physical exercises aimed at restoring and compensating for functions is developed taking into account combined injuries and includes various physical therapy methods aimed at stimulating brain neuroplasticity and optimizing cognitive processes. The use of a complex of rehabilitation measures helps to improve the ability to concentrate and maintain attention, develop short-term and long-term memory, increase the level of spatial and temporal orientation, as well as improve executive functions, in particular planning, decision-making, action control and cognitive flexibility. Such effects ensure increased efficiency of cognitive functioning and contribute to the formation of stable compensatory mechanisms in patients.

A comprehensive approach to the rehabilitation of children with the consequences of TBI involves a holistic combination of physical, cognitive, psychoemotional and social aspects of the rehabilitation process. As a result of TBI, children often experience not only motor disorders, but also a decrease in the level of attention, memory, thinking, and speed of information processing, which sig-

nificantly complicates the process of restoring motor and everyday skills. That is why the rehabilitation program should be interdisciplinary and based on the interaction of a physical therapist, occupational therapist, psychologist, speech therapist and a doctor of physical and rehabilitation medicine.

Physical therapy in this category of patients is aimed not only at restoring motor functions, coordination and balance, but also at stimulating cognitive processes through motor activity. It has been proven that a purposeful combination of motor and cognitive tasks during classes contributes to the activation of neuroplastic mechanisms, the improvement of interhemispheric connections and the formation of new functional pathways in the brain.

It is advisable to use exercises that require the simultaneous involvement of motor and mental components, for example: exercises for coordination with elements of memory, spatial orientation, attention or action planning. This approach not only increases the effectiveness of restoring motor skills, but also helps to improve cognitive functions, which, in turn, has a positive effect on the level of functional independence and the quality of life of the child.

Example of a weekly rehabilitation program for children with the consequences of TBI in a hospital setting (with an emphasis on cognitive functions).

Day 1 - Assessment and adaptation stage. Purpose: conducting a comprehensive assessment of the child's condition, forming an individual rehabilitation plan and adapting the patient to the rehabilitation environment.

- Cognitive assessment: determination of the level of attention, memory, executive functions (psychologist).
- Rehabilitation examination: assessment of muscle strength, range of motion, coordination and balance (physical therapist).
- Psychosocial adaptation: conversation with the child and parents to motivate them to participate in the rehabilitation process.
- Physical activity: breathing and passive motor exercises, gradual activation of motor skills.
- Cognitive therapy: game tasks to stimulate attention and short-term memory.

Day 2 – Stimulation of attention and sensory integration. Goal: improvement of concentration, sensory perception and coordination of movements.

- Physical activity: exercises for coordination, balance, fine motor skills.
- Cognitive therapy: tasks for concentration, finding and arranging objects, sensory games with different textures and colors.
- Play therapy: interactive exercises for the simultaneous development of motor and cognitive skills.
- Relaxation techniques: breathing exercises, music therapy.

Day 3 – Development of speech and executive functions. Goal: stimulation of speech activity, thinking and planning of actions.

- Speech therapy: articulation exercises, vocabulary expansion, exercises for the formation of oral expression.

- Cognitive therapy: exercises for planning a sequence of actions, logical thinking and solving simple problems.

- Physical activity: light aerobic exercises and coordination exercises in walking.

- Play therapy: board and mobile games that stimulate memory and attention.

Day 4 – Social skills and emotional regulation. Goal: development of social interaction, emotional stability and self-control.

- Psychological support: role-playing games, exercises for recognizing emotions, self-control training.

- Cognitive therapy: associative and flexible logical exercises.

- Physical activity: team games for coordination and balance.

- Relaxation techniques: music therapy.

Day 5 – Memory and concentration. Goal: increasing the efficiency of working and long-term memory, stimulating learning activities.

- Cognitive therapy: exercises for memorizing information, restoring sequences, interactive games for memory and attention.

- Physical activity: exercises for fine motor skills and coordination, combining motor and cognitive tasks.

- Play therapy: quests and tasks that combine motor and cognitive elements.

Day 6 – Integrative rehabilitation. Goal: a comprehensive combination of physical therapy and cognitive rehabilitation, stimulation of functional skills.

- Integrative exercises: performing motor tasks simultaneously with cognitive ones (step counting, memorizing sequences).

- Group work: team games that stimulate social and cognitive skills.

- Relaxation techniques: progressive muscle relaxation, breathing exercises.

Given the principles of evidence-based medicine, the practical activities of a physical therapist should be based on the use of modern, validated methods for assessing the functional state, cognitive abilities and behavioral characteristics of patients. Regular testing and surveys allow for an objective assessment of the dynamics of the rehabilitation process, determine the effectiveness of the applied program and make timely adjustments to achieve optimal recovery results.

In order to analyze the effectiveness of the implemented comprehensive rehabilitation of children who were involved in the study, testing was carried out at the beginning of individual work and in the context of the stages of rehabilitation.

To identify cognitive problems and assess cognitive functions, the Montreal Cognitive Function Assessment Scale was used, which covers indicators of attention, memory, executive functions, language, visual-constructive skills, abstract thinking and orientation. According to the data obtained during the initial testing, 2-9 points were scored in 2 children (20%); 10-19 points in 5 patients (50%); 20-22 points in 3 study participants (30%). $X \pm m = 15.3 \pm 2.04$. At the end of the study, according to the results of testing, in 6 children (60%) the indicator exceeded 26 points, which corresponds to the norm; in 2 patients (20%) it was 20–25 points; in 2 children (20%) - 10–19 points. The average value at the end of the study was 24.2 ± 1.78 , which indicates a statistically significant improvement in cognitive indicators compared to the initial data ($p < 0.001$). The dynamics of indicators is shown in Fig. 1

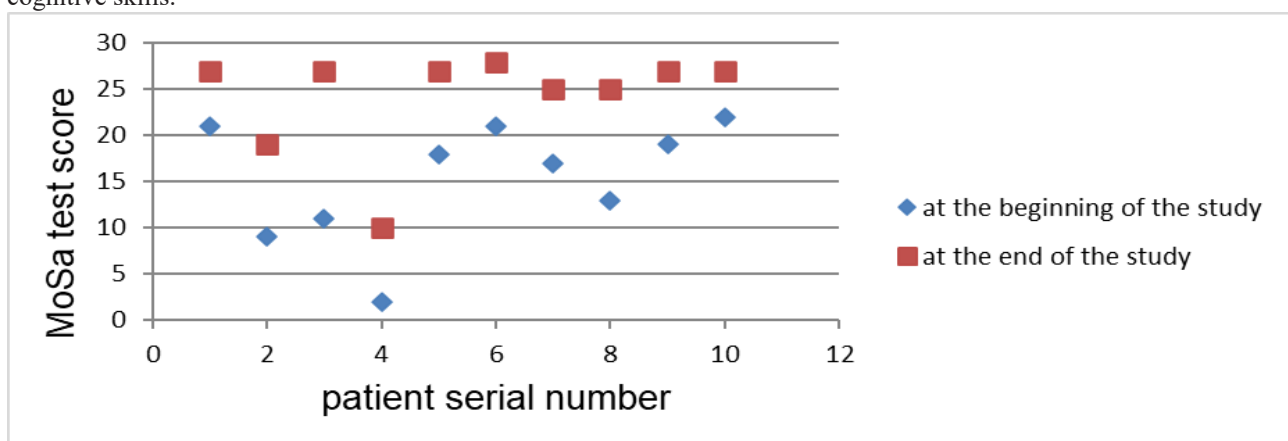


Fig. 1. Individual dynamics of cognitive function indicators according to the Montreal Assessment Scale.

In order to determine memory impairment and spatial-constructive skills, the “Clock Drawing” test was used. In the presence of cognitive impairments, memory problems, the patient makes inaccuracies and errors. The test result is evaluated on a 10-point scale. The data obtained at the beginning of the study: 1 point - in one patient (10%); 2 points - in 2 children (20%); 3 points - in 4 people (40%); 4 points - in 2 children (20%) and 5 points - in 1

patient (10%). $X \pm m = 3.0 \pm 0.36$. At the end of the study, the results showed the effectiveness of the multidisciplinary team: one patient (10%) received 4, 5 and 6 points; in 5 children (50%) the result was 7 points; in one child (10%) - 8 points, and in one (10%) - 9 points. The average value of the indicator was 6.7 ± 0.45 . The results obtained indicate a statistically significant improvement compared to the initial data ($p < 0.001$). The distribution of patients, ac-

According to the result of the «Clock Drawing» test, % is shown in Fig. 2

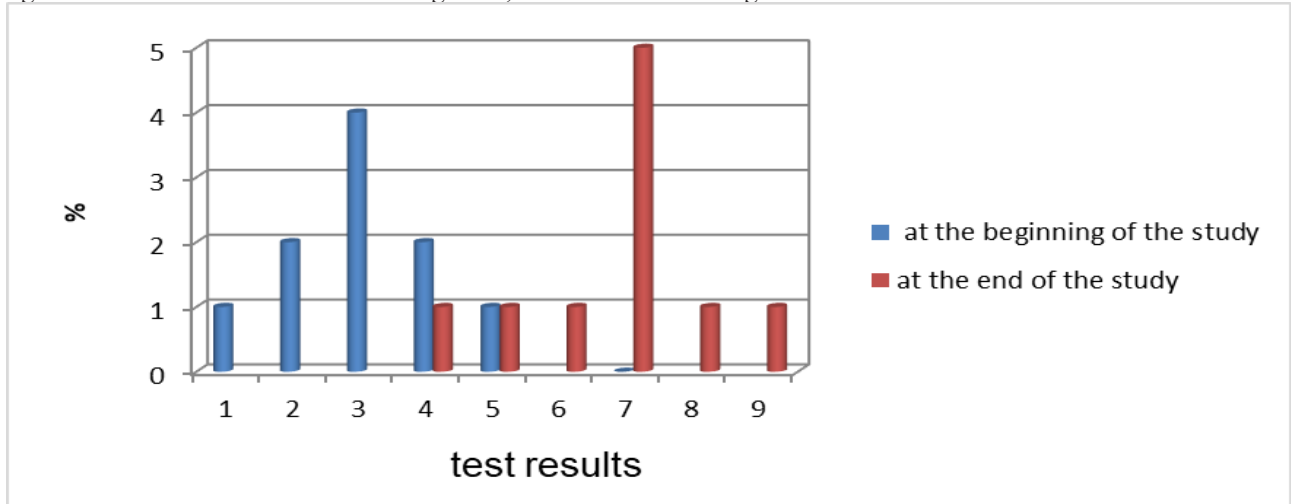


Fig.2 Distribution of patients according to the results of the “Clock Drawing” test, %

For a comprehensive assessment of the behavioral and cognitive functions of patients involved in the study, the 10-level Rancho Los Amigos Scale was used. It takes into account the level of assistance that a patient needs after TBI to perform cognitive and physical functions. According to the results obtained, one patient (10%) had level 3; 90% had level 5. Repeated examination showed positive dynamics in all children involved in the study. In particu-

lar, one patient (10%) had level 4, two children (20%) had level 6, five (50%) had level 7, and two (20%) had level 8. The results obtained indicate a general improvement in cognitive and behavioral indicators after the implementation of the physical therapy program. The distribution of patients according to the test results according to the Rancho Los Amigos Scale (%) is shown in Fig. 3.

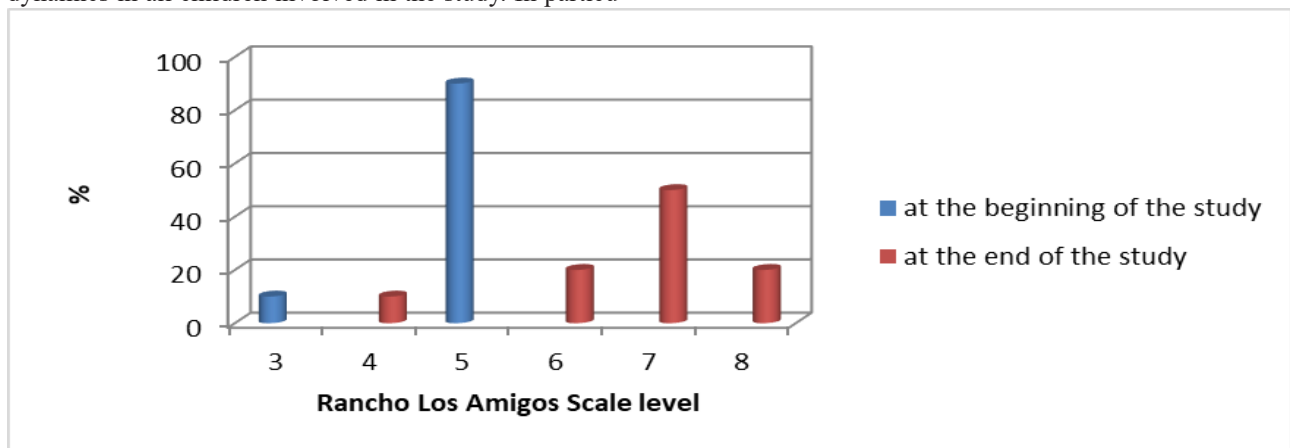


Fig. 3. Distribution of patients according to the Rancho LosAmigos Scale test results, %

Analysis of the results showed that for all studied indicators of cognitive abilities, there is a statistically significant difference in the indicators obtained at the beginning of the study and at the end of the implementation of a comprehensive rehabilitation program with the use of physical therapy.

It should be noted that in the process of planning and implementing a physical therapy program, it is necessary to take into account the individual characteristics of the patient, the level of preservation of cognitive functions, emotional state, as well as motivation for classes. A significant role in this context is played by psychological readiness and active participation of parents or guardians, since the effectiveness of recovery largely depends on the systematic performance of exercises and the continuation of therapeutic measures at home.

Conclusions. Despite modern achievements in neurosurgery and intensive care, TBI remains one of the leading causes of mortality and disability in the world. About a third of patients die in the prehospital stage, and another 20–30% in the hospital. Among those who survive, a significant proportion of individuals suffer from persistent impairments in work capacity and cognitive functioning. Children are a particularly vulnerable group, among whom 63–75% experience a delay in physical, cognitive, and mental development after TBI. Therefore, rehabilitation measures should be initiated as early as possible, as soon as the patient’s vital condition stabilizes.

The results of treatment of patients with TBI are determined by the timeliness and quality of medical care, starting from the prehospital stage, and the effectiveness of comprehensive rehabilitation. Successful rehabilitation

is based on the principles of evidence-based medicine, in particular, maintaining adequate brain perfusion, normoventilation, prevention of hypoxemia, hypercapnia, and intracranial hypertension. At the same time, an important component is secondary prevention of complications such as hyperthermia, hyponatremia, hyperglycemia and impaired water-salt balance.

A comprehensive physical therapy program for children with TBI should be individual, flexible and dynamic, adapted to the functional state of the patient and the dynamics of his recovery. Its structure includes elements of physical activity, cognitive therapy, speech and social and psychological interventions. The proposed weekly program demonstrated effectiveness in restoring not only motor but also cognitive functions of children, which was confirmed by the results of standardized tests - the Montreal Cognitive Assessment Scale, the Clock Drawing Test and the Rancho Los Amigos Scale.

Analysis of the results obtained showed a statistically significant improvement in cognitive indicators after the implementation of the program. In particular, the average score on the Montreal Scale increased from 15.3 ± 2.04 to 24.2 ± 1.78 points ($p < 0.001$), indicating a significant increase in the level of attention, memory and executive functions. According to the «Clock Drawing» test, the average score increased from 3.0 ± 0.36 to 6.7 ± 0.45 ($p < 0.001$), and the dynamics on the Rancho Los Amigos scale reflected an improvement in adaptive and behavioral capabilities. This proves that systemic rehabilitation with the use of physical therapy aids contributes to the activation of neuroplastic mechanisms, optimization of cognitive processes and the formation of compensatory strategies in children after TBI. It is important to emphasize that the effectiveness of the rehabilitation process depends not only on the methods, but also on the active participation of the family, patient motivation, psycho-emotional support and continuity of classes. It is the interaction of the child, parents and the multidisciplinary team that creates the conditions for the

maximum restoration of functional independence, social adaptation and improvement of the quality of life.

Thus, the results of the study confirm the feasibility of using a comprehensive, interdisciplinary approach in the physical rehabilitation of children with the consequences of traumatic brain injury. Such a strategy allows not only to restore impaired motor functions, but also to significantly improve cognitive, speech and behavioral capabilities, which is of great importance for the further development, education and social integration of the child.

The prospects for further scientific research include an expanded study of the effectiveness of the developed physical therapy program in restoring motor functions in children with the consequences of traumatic brain injury. In particular, it is advisable to analyze the dynamics of improving motor skills, coordination abilities, muscle strength and endurance under the influence of a comprehensive rehabilitation intervention.

Conflict of interest. The authors declare that they have no conflict of interest in relation to this research, including financial, personal, authorship or other nature, which could affect the research and its results presented in this article.

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Author contributions: a) conception and design; c) provision of materials for the study; d) collection and synthesis of data; e) analysis and interpretation of results; f) writing of the manuscript; b) administrative support; g) editing of the manuscript;

All authors have read and agreed with the published version of the manuscript.

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ВПЛИВ ТЕРАПІЇ ТА РЕАБІЛІТАЦІЇ НА КОГНІТИВНІ ФУНКЦІЇ ПАЦІЄНТІВ, ЯКІ ПЕРЕНЕСЛИ ЧЕРЕПНО-МОЗКОВУ ТРАВМУ

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Резюме. Проаналізовано ефективність індивідуальної програми фізичної терапії у дітей з наслідками черепно-мозкової травми (ЧМТ). За даними статистики, лише 50–60 % пацієнтів після стаціонарного лікування повністю відновлюються або мають мінімальні неврологічні порушення. У 63–75 % дітей, які перенесли ЧМТ, спостерігається затримка фізичного та психічного розвитку. Легка ЧМТ, як правило, минає без ускладнень, проте приблизно у 3 % випадків можливе раптове погіршення стану, що потребує своєчасного виявлення для запобігання розвитку серйозних неврологічних дисфункцій.

Мета дослідження: проаналізувати динаміку показників когнітивних функцій у дітей після перенесеної ЧМТ на стаціонарного етапу реабілітації.

Матеріали та методи дослідження. Дослідження проведено на базі медичного факультету Волинського національного університету імені Лесі Українки та КП «Волинське обласне територіальне медичне об'єднання захисту материнства і дитинства». У дослідженні взяли участь 10 дітей віком 8–17 років, які перенесли ЧМТ. Усі пацієнти та їхні батьки були ознайомлені з умовами дослідження й надали інформовану згоду на участь. Про-

ведено аналіз історій хвороб, соматичне та неврологічне обстеження. Комплексна реабілітація із застосуванням засобів фізичної терапії здійснювалася у стаціонарних умовах на підгострому етапі відновлення. Для оцінювання ефективності використовували Монреальську шкалу когнітивної оцінки (MoCA), тест «Малювання годинника» та Шкалу Ранчо Лос-Амігос.

Результати. Аналіз отриманих результатів показав статистично значуще покращення когнітивних функцій у пацієнтів після комплексної програми терапії та реабілітації, зокрема, у сферах пам'яті, уваги та виконавчих функцій. За результатами оцінювання когнітивних функцій за Монреальською шкалою (MoCA) середнє значення наприкінці дослідження склало $24,2 \pm 1,78$, що підтверджує статистично значуще покращення ($p < 0,001$). Тест «Малювання годинника» показав середній бал $6,7 \pm 0,45$ із суттєвим прогресом, порівняно з початковими показниками ($p < 0,001$). Комплексна оцінка когнітивно-поведінкових функцій за шкалою Ранчо Лос-Амігос засвідчила покращення у всіх пацієнтів.

Висновки. Незважаючи на сучасні досягнення нейрохірургії та інтенсивної терапії, ЧМТ залишається однією з провідних причин смертності та інвалідизації у світі. Близько третини пацієнтів помирають на догоспітальному етапі, а ще 20–30 % — у стаціонарі.

Успішна реабілітація ґрунтується на принципах доказової медицини, зокрема підтриманні адекватної перфузії мозку, нормовентиляції, профілактиці гіпоксемії, гіперкапнії та внутрішньочерепній гіпертензії. Водночас важливою складовою є вторинна профілактика ускладнень, таких як гіпертермія, гіпонатріємія, гіперглікемія та порушення водно-сольового балансу.

Комплексна програма фізичної терапії у дітей з наслідками ЧМТ повинна бути індивідуальною, гнучкою та динамічною, адаптованою до функціонального стану пацієнта та динаміки його відновлення. Її структура включає елементи фізичної активності, когнітивної терапії, мовленнєвих і соціально-психологічних інтервенцій. Запропонована тижнева програма продемонструвала ефективність у відновленні не лише рухових, але й когнітивних функцій дітей, що підтверджено результатами стандартизованих тестів — Монреальської шкали оцінки когнітивних функцій, тесту «Малювання годинника» та Шкали Ранчо Лос Амігос.

Дослідження підтвердило важливість комплексного підходу в реабілітації дітей з наслідками ЧМТ, що включає фізичну терапію як основний компонент відновлення когнітивних функцій.

Ключові слова: фізична терапія, черепно-мозкова травма, когнітивні порушення, реабілітація, MoCA, тест малювання годинника.

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