ANALYSIS OF INTERNATIONAL EXPERIENCE IN PHYSICAL THERAPISTS' WORK WITH PATIENTS IN COMA AND WITH PROLONGED DISORDERS OF CONSCIOUSNESS IN INTENSIVE CARE UNITS

АНАЛІЗ МІЖНАРОДНОГО ДОСВІДУ РОБОТИ ФІЗИЧНИХ ТЕРАПЕВТІВ ІЗ ПАЦІЄНТАМИ В КОМІ ТА З ТРИВАЛИМИ РОЗЛАДАМИ СВІДОМОСТІ В УМОВАХ ВІДДІЛЕНЬ ІНТЕНСИВНОЇ ТЕРАПІЇ

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Abstracts

Purpose. This study aimed to analyze the international experience of physical therapists working with patients in coma and those with prolonged disorders of consciousness in intensive care units, as well as to assess the feasibility of adapting this experience to Ukrainian healthcare settings. The lack of unified guidelines and adapted rehabilitation protocols in Ukraine hinders the effective recovery of such patients. Examining international experience may support the development of national recommendations and their integration into clinical practice. **Materials and methods.** An analysis of 76 scientific articles from eight electronic databases (PubMed, Cochrane Library, Google Scholar, etc.) was conducted using keywords such as coma, rehabilitation, mobilization of coma patients, prolonged disorders of consciousness, and physical therapy in intensive care. The study examined modern approaches to early mobilization, respiratory therapy, sensory and tactile stimulation, and patient positioning, as well as their potential application in Ukraine. **Results.** Key aspects of rehabilitation were identified, including early mobilization, respiratory therapy, tactile and sensory stimulation, and patient positioning. A review of contemporary international protocols and recommendations demonstrated their effectiveness in the recovery of patients in coma and with prolonged disorders of consciousness. It was found that the application of standardized protocols and guidelines significantly improves rehabilitation outcomes even in resource-limited settings. The study substantiated the rationale for adapting international protocols to Ukrainian healthcare to improve rehabilitation outcomes for patients with consciousness disorders. **Conclusions.** International experience in physical therapy for patients in coma is a valuable resource for developing national protocols. Recommendations that incorporate the experience of other countries could help improve outcomes for patients in critical conditions in Ukrainian healthcare institutions, even with limited resources.

***Key words*:** coma, prolonged disorders of consciousness, intensive care unit, early mobilization, physical therapy in intensive care.

Мета. Це дослідження мало на меті проаналізувати міжнародний досвід роботи фізичних терапевтів з пацієнтами в комі та з тривалими розладами свідомості у відділеннях інтенсивної терапії, визначити можливості його адаптації до умов української системи охорони здоров'я. Відсутність уніфікованих рекомендацій та адаптованих реабілітаційних протоколів в Україні значно ускладнює ефективне відновлення таких пацієнтів. Вивчення міжнародного досвіду може сприяти розробці національних рекомендацій та їх впровадженню в клінічну практику. **Матеріали і методи.** Проведено аналіз 76 наукових статей з восьми електронних баз даних (PubMed, Cochrane Library, Google Scholar та ін.), використовуючи ключові слова: кома, реабілітація, мобілізація пацієнтів у комі, тривалі розлади свідомості, фізична терапія в реанімації тощо. Досліджувалися сучасні підходи

до ранньої мобілізації, дихальної терапії, сенсорної та тактильної стимуляції, позиціонування пацієнтів, а також їх можливе застосування в Україні. **Результати.** Виявлено ключові аспекти реабілітації, зокрема ранню мобілізацію, дихальну терапію, тактильну та сенсорну стимуляцію, а також позиціонування пацієнтів. Розглянуто сучасні міжнародні протоколи і рекомендації та їх ефективність у відновленні пацієнтів у комі та з тривалими розладами свідомості. З'ясовано, що застосування стандартизованих протоколів та рекомендацій значно покращує ефективність реабілітації навіть за умов обмежених ресурсів. Обґрунтовано доцільність адаптації міжнародних протоколів до українських реалій для підвищення ефективності реабілітації пацієнтів з порушеннями свідомості. **Висновки.** Міжнародний досвід фізичної терапії пацієнтів у комі є цінним ресурсом для розробки національних протоколів. Рекомендації щодо врахування досвіду інших країн можуть сприяти покращенню результатів лікування пацієнтів із критичними станами в українських медичних закладах навіть за обмежених ресурсів.

***Ключові слова*:** кома, тривалі розлади свідомості, відділення інтенсивної терапії, рання мобілізація, фізична терапія в реанімації.

Introduction. Modern technology advancements have enabled breakthroughs in organ transplants, including those grown in laboratory conditions, and improved technical support, especially in intensive care and resuscitation departments. This progress has increased survival rates among critically ill patients. However, cardiovascular diseases, neurological disorders, and head trauma cases continue to rise, exacerbated by daily stress and, in Ukraine, the impact of ongoing military actions. Consequently, a significant number of patients in critical conditions, including those in coma or with prolonged consciousness disorders, require innovative rehabilitation approaches. The lack of unified recommendations and adapted protocols for rehabilitation in Ukrainian intensive care units (ICUs) limits the effectiveness of patient recovery post-coma. Studying and analyzing established recommendations and protocols from other countries can facilitate the development of adapted recommendations for Ukraine and support their implementation in practice.

Most authors studying the impact of physical therapy on coma patients [3; 4] reduced time on mechanical ventilation or, for example, early mobilization and verticalization of patients, which reduces the risk of complications. Research particularly highlights the importance of early mobilization, especially for patients on mechanical ventilation [3; 11; 23].

Rehabilitation for patients in coma for more than two weeks presents unique challenges, as coma can result from various factors and causes [8; 9; 10; 12]. Accordingly, rehabilitation outcomes may vary depending on the severity and cause of the coma, but generally, many studies indicate significant improvement in recovery chances when physical therapy is applied [13; 15; 17].

Thus, we can highlight the main aspects of research aimed at improving rehabilitation outcomes for patients in coma and those with prolonged disorders of consciousness. Physical therapy plays an essential role, even for patients who have not yet emerged from coma, as it helps prevent complications such as muscle contractures, pressure sores, or respiratory issues. Early physical interventions can enhance long-term outcomes by supporting joint mobility and circulation. Neurological studies confirm that patients may gradually emerge from coma, initially showing improvements in basic responses such as eye movements and reflexes before cognitive and motor functions return [14; 16]. Patients recovering from prolonged coma typically require extended rehabilitation involving both cognitive and physical therapy [18; 19]. Physical and speech therapy play significant roles in restoring speech skills, motor function, and daily task performance. Research shows that, due to the brain's neuroplasticity, some patients can regain functions previously thought lost [10; 12]. Recent studies also examine methods for brain stimulation and the use of medications to enhance neuron regeneration [2; 4].

Many researchers [5; 20] emphasize the importance of individualized rehabilitation plans tailored to each patient's physical and cognitive needs. Recovery is gradual and requires a

multidisciplinary approach [33], involving medical and sanitary care, physical therapy combined with medication, psychological support for families, and post-coma support for the patient. Patients also receive neuropsychological support to help restore cognitive functions following an extended coma [1].

In addition, many countries have protocols for providing physical therapy to patients in a comatose state. In countries such as the United States and the United Kingdom, early mobilization and rehabilitation are emphasized to improve recovery outcomes and minimize complications. Rehabilitation programs for patients with prolonged consciousness disorders include physical therapy measures such as limb stimulation, regular body positioning changes, and other measures to prevent secondary complications, particularly pressure sores and muscle contractures. Additionally, neuro-monitoring technologies play an essential role in tracking brain activity and adapting rehabilitation therapy as consciousness levels change [6; 21; 22; 28].

In the United States, the American Physical Therapy Association (APTA) has developed updated guidelines for patients with consciousness disorders, including those in coma. The primary goals are early mobilization, the use of neurostimulators, physical therapy, and sensory channel stimulation ("Physical Management of Patients in a Disorder of Consciousness (DOC): Promoting Best Practice in UK through Development of Clinical Practice Guidelines," n.d.). One protocol example includes the use of multisensory stimulation, music therapy, and physical exercises for patients with consciousness disorders at various coma stages. These guidelines emphasize a multidisciplinary approach to rehabilitation, where physical therapists work collaboratively with neurologists and other specialists [26].

In the Netherlands, evidence-based guidelines have been developed for physical therapists in intensive care units. These guidelines include clinical justifications for diagnostics and interventions, safety criteria for patients with consciousness disorders, as well as assessments of functional limitations and interventions to improve patients' conditions [20]. In Germany and Sweden, several scientifically grounded protocols are available for physical therapists working with comatose patients. For example, in Germany, one of the key documents includes recommendations for physical therapy in ICU settings ("Physiotherapy in ICU," n.d.). The protocols emphasize early mobilization, the customization of treatment plans based on patient condition, and continuous monitoring of vital signs to ensure safe therapy. In Sweden, recommendations based on systematic literature reviews and international studies also focus on early mobilization methods for patients with traumatic brain injuries, including vertical positioning and proper patient alignment [26]. Research explores the effectiveness of physical therapy in restoring consciousness in post-coma patients.

In Poland, the National Health Foundation (NFZ) provides guidelines on the treatment and rehabilitation of children and adults in comatose states [2; 7]. These guidelines cover early rehabilitation initiation, individualized treatment plans according to patient condition, nutrition, and recommendations for at-home rehabilitation interventions, especially for patients in vegetative states. Some studies [12; 27] highlight the importance of assessing the quality of life for these patients and their families.

These protocols or recommendations are actively implemented in medical facilities and regularly updated based on the latest research in the rehabilitation of patients in coma or with prolonged consciousness disorders. Such protocols aim to stimulate the patient's body, reduce the risk of infections and complications, and support recovery following the coma.

The aim of this study is to analyze and summarize the recommendations provided in EU countries, the United States, and the United Kingdom regarding the care of patients in coma or with prolonged disorders of consciousness, with the goal of evaluating their applicability in Ukraine.

Materials and methods of research. To assess the effectiveness of rehabilitation

interventions for patients in coma or with prolonged consciousness disorders in intensive care units, 76 scientific articles from eight electronic databases were reviewed and analyzed. Searches were conducted in electronic databases, including Pubmed, The Cochrane Library, Google Scholar, Researchgate, Cp-medical, Biomedcentral, Humanfocus, Polish Medical Bibliography, and the official websites of medical organizations such as ESICM (European Society of Intensive Care Medicine), NICE (National Institute for Health and Care Excellence), and SCCM (Society of Critical Care Medicine). Key search terms included: coma, rehabilitation, patient mobilization in coma, prolonged consciousness disorders, post-coma complications, physical therapy in ICU, care for patients with consciousness disorders, post-traumatic coma, vestibular stimulation for consciousness disorders, music therapy for coma patients, coma disability rating scale, Rancho Los Amigos scale, Glasgow coma scale, etc.

The choice of keywords is essential in conducting a systematic search in such a specialized field as coma and prolonged consciousness disorder rehabilitation. The selection of keywords is based on factors such as relevance to the research topic. For example, keywords such as "coma," "prolonged consciousness disorders," and "post-coma complications" relate directly to key concepts associated with the patient condition, helping focus the search on cases that cover the patient's state from loss of consciousness to the recovery phase.

Keywords such as "coma patient mobilization," "physical therapy in ICU', and "care for patients with consciousness disorders" are crucial for exploring physical therapy interventions. Terms like "Glasgow Coma Scale," "Rancho Los Amigos Scale," and "post-coma disability rating scale" are standard tools for measuring consciousness level and patient condition. Including these keywords allows access to literature not only on interventions but also on patient monitoring and the effectiveness of interventions or treatments.

Keywords such as "vestibular stimulation in consciousness disorders" and "music therapy for coma patients" reflect various methods of stimulation and activation for comatose patients, which are also part of comprehensive rehabilitation. The broad range of terms, including "coma", "post-traumatic coma", and "coma scales", allows a wide-reaching perspective, avoiding narrow limitations on the issue and enabling the inclusion of diverse approaches for patients in various types of comatose states, as available in open-access sources.

Thus, the selected keywords were chosen to focus on specific aspects of scientific research-from diagnosis to rehabilitation interventions and assessment of their effectiveness. We believe this ensured a comprehensive literature review and minimized the risk of missing potentially critical data.

The informational search yielded 76 publications, with 54 meeting inclusion criteria, providing information on the rehabilitation of patients in post-traumatic coma and following their awakening, consciousness disorders caused by accidents, and prevention of complications from prolonged immobility.

The literature on rehabilitation for comatose or prolonged disorder of consciousness patients covers concepts such as early mobilization, physical therapy, breathing exercises, passive movements, verticalization, physical therapy in intensive care or ICU, therapy for patients on mechanical ventilation, positioning, music therapy, and therapies for speech, facial expressions, swallowing, and breathing, as well as patient care.

Discussion of results. Based on our analysis, we propose specific recommendations to incorporate the experience of foreign specialists in further developing protocols for intensive care units in Ukraine.

1. Early passive mobilization within the first two days, aimed at preventing muscle contractures and maintaining joint mobility. Passive movements are performed by a physical therapist on the patients' upper and lower limbs. Some authors recommend performing such movements at least twice daily.

2. Positioning or placing the patient in certain positions involves regularly changing body position every 2–3 hours to prevent pressure sores and improve blood circulation and lung ventilation.

3. Respiratory therapy includes manual therapeutic interventions to support lung ventilation, enhance coughing, and improve chest mobility. This therapy is especially important for patients on mechanical ventilation, as it helps prevent pneumonia and improves tissue oxygenation.

4. Central nervous system stimulation through tactile, auditory, and visual stimuli, which can activate brain activity, aid in consciousness recovery, and enhance cognitive responses.

5. Early verticalization of patients, including adjusting the bed position from a 45-degree head lift to sitting with legs down, or using specialized devices like tilt tables. Early verticalization is beneficial for respiratory complication prevention, and for patients on mechanical ventilation, it can reduce ventilator dependency.

6. Continuous monitoring of physiological changes to adjust physical therapy interventions. Regular patient monitoring allows the assessment and adjustment of the rehabilitation program based on health changes. Monitoring blood pressure, heart rate, blood oxygen levels, and body temperature helps detect complications such as infections or respiratory issues that require immediate intervention. Continuous monitoring of pupillary reactions, consciousness levels, and brain activity (using EEG) allows tracking the recovery of brain functions and detecting potential signs of emergence from a coma. Electromyography (EMG) can be used to monitor muscle tone and detect signs of motor activity or involuntary reactions, which may indicate the gradual restoration of motor functions. Regular monitoring enables the adaptation of rehabilitation programs, allowing adjustments in therapy intensity or type (physical therapy, respiratory therapy, etc.) based on health changes. For example, changes in muscle activity or reflexes can indicate the potential for increased motor activity. Therefore, monitoring is essential for adjusting interventions, reducing risks, and ensuring the most effective rehabilitation for comatose patients.

7. Psychological support for the family. Supporting the patient's relatives can help reduce family stress, positively impact the patient's psychological state, and contribute to better recovery outcomes.

8. Physical therapy and occupational therapy. Engaging patients in simple motor tasks to stimulate brain activity and improve the likelihood of motor function recovery is recommended upon emergence from a coma and when some motor skills are present. Active patient involvement becomes feasible in later recovery stages after a coma.

These rehabilitation aspects are essential according to numerous scientific studies and contribute to the improvement of coma patients' conditions. Many of these aspects are present in intervention protocols across EU countries, the UK, and the US, and are used in treating patients in coma or with prolonged consciousness disorders.

A comprehensive analysis of scientific research also highlights the existence of other rehabilitation methods for coma patients, such as acupuncture, intensive trigger-point massage, manual therapy, and traditional Chinese medicine techniques, which lack scientifically substantiated evidence of efficacy.

Given most recommendations and protocols derived from scientific research, it is crucial for the Ukrainian Ministry of Health to create standardized recommendations or protocols for managing such patients in Ukraine.

The results of this analysis suggest the following recommendations for implementing protocols for physical therapists working with coma patients and those with prolonged consciousness disorders in Ukraine's healthcare system. Considering the specifics of the Ukrainian healthcare system, focus should be placed on these aspects:

1. Gradual integration of international protocols:

Implement early mobilization practices starting with pilot projects in larger medical

facilities with the necessary resources. Based on successful examples, these practices can later be introduced in smaller hospitals.

Adapt international protocols based on early mobilization protocols in intensive care from the UK and US, proven effective, to fit the Ukrainian context.

2. Healthcare personnel training:

Organize training sessions for physical therapists, focusing on mobilizing coma patients and those with prolonged consciousness disorders, using examples from leading European practices (Germany, the Netherlands, etc.).

Introduce postgraduate programs for intensive care doctors and physical therapists, emphasizing innovative approaches to coma patient care. Any pilot project intended to scale nationally requires a skilled workforce to support its future expansion. Therefore, it is essential for educational institutions to integrate relevant disciplines into the "Physical Therapy, Occupational Therapy" curriculum to build a competent cadre in this field.

3. Development of national protocols:

It is essential to create national protocols that are adapted to the realities of the Ukrainian healthcare system but based on international recommendations. This will enable effective application of early mobilization methods in resource-limited settings. Today, it is crucial to initiate such programs without requiring significant resources. This should include consideration of adequate staffing for physical therapists specifically within intensive care units.

4. Efficient resource utilization:

Considering the limited financial resources in some healthcare facilities, basic mobilization therapy should be implemented, including passive movements, position changes, and sensory stimulation, which do not require expensive equipment. Physical therapy plans that can be implemented even in hospitals with limited equipment and minimal resources should be developed.

Currently, in most Ukrainian medical facilities, physical therapists are not permanent ICU staff; they supervise the ICU and provide rehabilitation interventions only at the request of the ICU physician, involved solely based on the specialist's discretion. Literature analysis suggests that a physical therapist employed as a permanent member of the ICU team – able to monitor the patient's status and functional indicators throughout the day – could significantly enhance rehabilitation efforts. This role would improve communication with ICU staff and strengthen the multidisciplinary team dynamic.

5. Monitoring and evaluation of interventions:

A monitoring system for evaluating the effectiveness of early mobilization or other physical therapy interventions is needed, allowing for assessment and adjustment based on individual patient needs. For example, intervention records in the medical history or dedicated tracking cards to document intervention time and patient progress would be helpful.

Discussion. This research emphasizes the significance of rehabilitation recommendations for comatose patients based on international experience. Practices in Germany, the Netherlands, and Poland, where systematic approaches to early mobilization, verticalization, and positioning have shown improved patient recovery rates, serve as valuable models. Special attention is paid to physical therapy for brain injury patients and its role in regaining consciousness. Protocols from Poland emphasize early intervention and individualized treatment plans, particularly for patients in a vegetative state, considering patient and family quality of life.

Previous studies [4; 5; 24; 29] report positive outcomes from early mobilization, including reduced risk of infections and complications such as muscle contractures, pressure ulcers, and pneumonia. However, the question remains as to how these protocols can be adapted in Ukraine, given current resources and systemic limitations.

A critical aspect of this study is confirming the effectiveness of early rehabilitation intervention, which, as studies in the UK, USA, Germany, the Netherlands, Poland, and other countries show [25; 30; 31; 32], reduces ICU stay duration, improves lung ventilation, lowers complication risks, and increases patient recovery prospects. Ukrainian researchers [33; 34] have also

highlighted the benefits of early rehabilitation intervention in critically ill patients. Our findings align with these studies but expand on practical adaptations of recommendations in resource-limited countries.

The study demonstrates that early mobilization, physiological monitoring, and individualized rehabilitation plans can serve as the foundation for developing national rehabilitation protocols in Ukraine. Involving family members in therapy decisions, especially regarding the continuation or cessation of active interventions, is also a vital component.

Practical implications and future research. Given the positive impact of rehabilitation interventions on improving outcomes for patients in comas or with prolonged consciousness disorders, further research should explore opportunities for expanding existing international protocols and adapting them to the conditions of Ukraine's healthcare system.

Conclusions. Early mobilization of comatose patients is a crucial part of the rehabilitation process that enhances physical and cognitive recovery. Studies conducted in the United Kingdom, the United States, Germany, Sweden, and other countries confirm the effectiveness of early interventions in reducing complications such as muscle contractures, pressure sores, pneumonia, and in stimulating consciousness recovery.

Based on international experience, several key points can be highlighted:

– Early mobilization is critically important for improving patient quality of life and recovery prospects. This approach enhances survival rates, improves lung ventilation, reduces ICU stays, and lowers the risk of complications from prolonged bed rest.

– Continuous physiological monitoring and individualized rehabilitation plans are essential for optimizing interventions and minimizing risks.

– Family involvement in decision-making is important, especially when considering the continuation or discontinuation of active therapy.

Given the current state of Ukraine's healthcare system, these recommendations can form the basis of national protocols that will provide effective rehabilitation even in resource-limited hospitals, improving outcomes for patients in comatose states.

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