

# PHYSIOTHERAPEUTIC MANAGEMENT OF A PATIENT AFTER CRANIOCEREBRAL TRAUMA IN THE INTENSIVE CARE UNIT – A CASE REPORT

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## ABSTRACT

**Background:** Craniocerebral injuries are one of the most common causes of mortality and disability in Poland. The treatment of patients who are in an intensive care unit is based primarily on stabilizing the patient's general condition as well as basic duties according to the patient's functioning.

**Aim of the study:** The aim of this study is to demonstrate the importance of early rehabilitation and the role of physiotherapy in recovery after craniocerebral trauma.

**Case report:** The subject was an 18-year-old patient who suffered craniocerebral trauma as a result of a road accident. After losing consciousness, he was in the intensive care unit, where he was placed on a medical ventilator. A properly selected physiotherapeutic procedure was performed. Passive exercises, contracture correction and appropriate positioning were used. To prevent pressure sores, anti-bedsore prophylaxis was implemented. Respiratory therapy played a key role. The goal of respiratory physiotherapy was to improve respiratory function by maintaining proper lung ventilation, increasing chest and diaphragm mobility along with maintaining the efficiency of respiratory muscles, as well as stimulating effective coughing and evacuation of secretions. The NDT-Bobath concept was used as therapy for spastic tension. The goal of the therapy was to get rid of pathological movement patterns and replace them with physiological patterns. The PNF method, classical and lymphatic massage, polysensory stimulation and music therapy were also used.

**Conclusions:** Early and comprehensive rehabilitation in a patient after craniocerebral trauma is extremely important and determines therapeutic effectiveness. Comprehensive therapy and care are able to prevent a number of complications that threaten the patient as a result of immobilization.

**KEYWORDS:** craniocerebral trauma, coma, rehabilitation

## BACKGROUND

Craniocerebral trauma is an important cause of mortality and disability in Poland. The development of diagnostics and therapies for craniocerebral trauma, whose incidence rises along with the development of communication, industry, as well as with increased gunshot wounds and recreational sports practitioners, leads to the most difficult rehabilitation problems. People who have been seriously injured are hospitalized [1]. In highly developed countries, craniocerebral injuries are the most common cause of death among the population in the first four decades of life. Treatment of trauma patients requires accurate decision-making and high professional qualifications. Patients

with multi-organ injuries are managed by a multi-disciplinary team composed of specialists from various fields of medicine [2,3].

Treatment of patients who are in the intensive care unit is initially based on stabilizing the patient's general condition and restoring basic physical performance. For patients who have limited contact, rehabilitation therapy should additionally combine sensory channel stimulation and advanced functional mobilization using neurophysiological methods, in addition to the use of posture positions, passive exercises and respiratory mobilization. The goal is also to improve basic life functions such as breathing and swallowing [4,5].

Returning to the best possible fitness involves organizational, psychological, medical, social and educational activities. The whole range of physiotherapeutic activities is aimed at supporting the process of natural regeneration, as well as the elimination of mental and physical effects of the disease [6].

**AIM OF THE STUDY**

The aim of this study is to demonstrate the importance of early rehabilitation and the role that physiotherapy plays in the recovery of patients after craniocerebral and multiorgan injuries.

**CASE REPORT**

The subject of this study is an 18-year-old patient who suffered a craniocerebral trauma secondary to

a road accident. As a result of this incident, he was sent to the Hospital Emergency Department of the University Clinical Hospital in Opole, where he lost consciousness and was transferred to the intensive care unit. The coma lasted for about six weeks. At that time, the patient was intubated and then put on a medical ventilator (respirator). During the full loss of consciousness, he was under the care of many specialists. Intensive pharmacological treatment was implemented. In addition, specialist rehabilitation was carried out throughout this period to support basic life processes.

Due to open fractures in both femurs, external stabilization was required (Fig. 1–2).

Later, anastomosis with the intramedullary nail was performed (Fig. 3–4).

There was also a fracture of the left ninth rib accompanied by bilateral lung contusion. In addition, an ocular



Figure 1. X-ray of the femur after external stabilization [authors' image].



Figure 2. External stabilization after bilateral femoral fracture [authors' image].



Figure 3. An X-ray of the femur after surgery with intramedullary nail [authors' image].



Figure 4. The condition of the lower extremities after surgery using an intramedullary nail [authors' image].

hematoma of the left eye was present. A tracheostomy was also required.

The patient developed spastic tension affecting the upper and lower limbs (Fig. 5–6).



Figure 5. Spastic right upper limb [authors' image].



Figure 6. Spastic tension in the feet [authors' image].

A properly selected physiotherapeutic procedure has been implemented. Passive exercises, contracture correction and appropriate positioning were used. This prevented the development of muscle contractures and paresis. During passive exercises, it was important not to exceed the current range of motion, as dislocation of joints could occur. Passive exercises were performed several times a day in two series of 12 movements. The

physiotherapist performed elbow, shoulder, wrist and hand exercises. Then, ankle and toe exercises were performed. They were also one of the basic anticoagulant exercises required for comatose patients. In addition, a higher position of the lower limbs was used to protect the patient from thrombosis, so that they were above the level of the heart.

To prevent pressure sores, anti-bedsore prophylaxis was used. Every two hours the patient was given a change of position. It was possible thanks to appropriately designed wedges and rollers and the use of anti-bedsore discs protecting elbows, buttocks, hips, knees, ankles and heels. In addition, the patient was placed on an anti-bedsore mattress, which prevented excessive pressure on the areas most vulnerable to pressure sores. The patient was monitored daily in areas prone to pressure sores. The whole-body toilet, maintaining high hygiene standards, keeping the patient's bed clean and ventilating the room was also very important. Due to such care, bedsores were fully prevented.

The bronchial toilet was another aspect of the treatment process. The patient's lungs were patted in individual segments. This was followed by suction and removal of residual secretion by an electric suction device. The frequent bronchial toilet provided airway patency, optimal gas exchange conditions, and acted as infection prevention.

Respiratory therapy played a key role [7]. The goal of respiratory physiotherapy was to improve respiratory function by maintaining proper lung ventilation, increasing chest and diaphragm mobility along with maintaining the efficiency of respiratory muscles, as well as stimulating effective coughing and evacuation of secretions. The patient worked on increasing three dimensions of the chest: upper-lower by lowering the diaphragm, anteroposterior through contraction of the external intercostal muscles located between successive ribs from I to V, as well as transverse, causing contraction of intercostal muscles located between successive ribs from VI to X.

Chest springing was applied, which consisted of compression of the lower part of the chest during exhalation and sudden release of the pressure at the beginning of inspiration (Fig. 7).

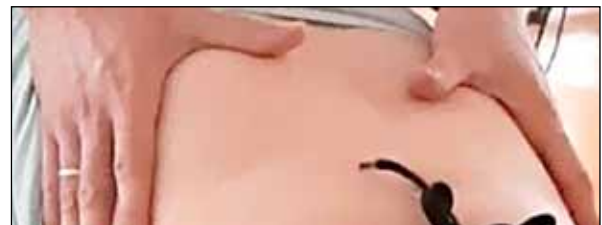


Figure 7. Chest springing technique [authors' image].

By introducing the forced exhalation technique, secretions from the upper respiratory tract were removed. Effective exhalation was also worked upon.

Turning the diaphragm movement on by blocking it was a great technique (Fig. 8). The therapist placing



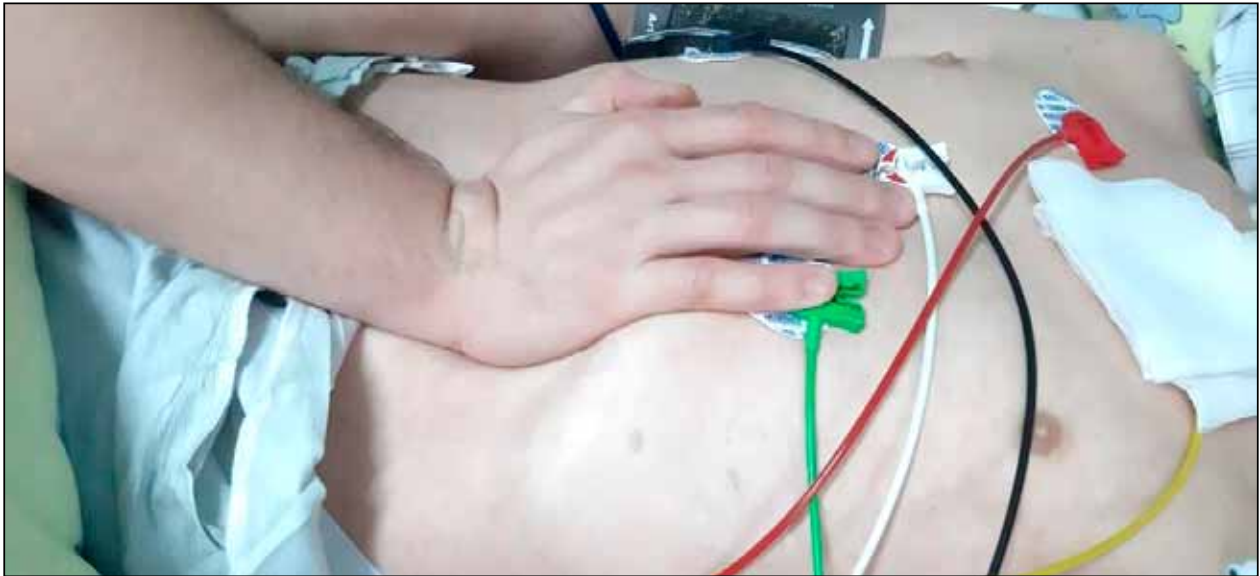


Figure 8. Mobilization of the diaphragm – the initial stage [authors' image].

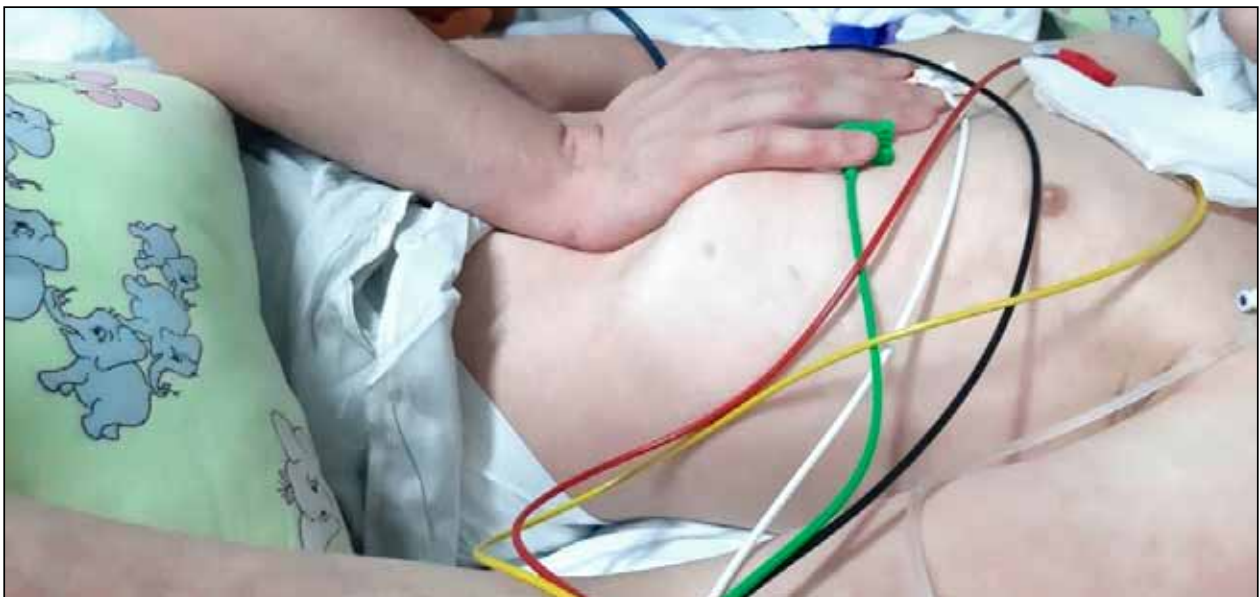


Figure 9. Mobilization of the diaphragm - the final stage [authors' image].

the patient's wrist on the diaphragm blocked the diaphragm when he inhaled. Then during exhalation, it was still maintained. With each breath, the range of movement increased (Fig. 9).

Then, the rib part of the diaphragm was mobilized. The chest opening technique was performed in a lying position backwards or lying sideways (Fig. 10). Following the chest opening technique, the chest closing technique was used (Fig. 11).



Figure 10. The chest opening technique while lying on its side [authors' image].



Figure 11. The chest closing technique [authors' image].

The patient did not have serious respiratory complications due to chest physiotherapy. Classic massage was also used in the therapy. The aim of the massage was to improve the blood supply and nutrition of tissues, accelerate the removal of unnecessary metabolism products, relax excessively contracted muscles, improve muscle flexibility, stimulate flaccid muscles as well as reduce and eliminate tissue adhesions and scars.

Alternately with classical massage, lymphatic massage was used. It improved the outflow of lymph, thanks to which edema of the upper and lower limbs was reduced.

The patient's upright standing required special caution. It started in a bed with high support, gradually increasing the angle of inclination and at the same time extending the duration of the vertical position. The next and more advanced stage involved sitting with the lowered lower limbs (Fig. 12). The moment of uprighting required continuous monitoring of pulse and blood pressure as well as a careful observation of the patient.

It was important to carry out global, complex movements, involving all components, which was achieved by the usage of PNF patterns. Early rehabilitation using the PNF method is effective in patients with neurological disorders, including patients in a coma and in the intensive care unit [4,8]. Before implementing this type of therapy, it was very important to know the range of mobility of individual joints to avoid later complications. Due to femoral fractures, the lower limb and pelvic patterns were not used, only the upper limb and torso patterns.

The NDT-Bobath concept was used as a therapy for spastic tension. The goal of the therapy was to get rid of pathological movement patterns and replace them with physiological patterns. Basic activity was monitored by mobilizing the sternum in bed, which prepared the extensors of the pelvis and lower limbs for fulfilling their body support function. The derotation of the lower trunk is one of the methods inhibiting lower limb spasticity. It was performed by stretching the spine extensor and multifiber muscles. The patient was then prepared to move from lying on their back to lying on their side and then sitting. This therapy improved abdominal oblique muscle control while silencing the overactive torso extensors. The therapist mobilized the greater round muscle in both upper limbs to prevent these muscles from working properly. An inhibition technique was also used to fight the spastic muscles of the wrist flexors and flexor digitorum longus. Hand therapy was conducted in order to inhibit finger flexor spasticity while preparing the hand for opening. The work of the upper limbs on supportive activity in closed chains also played a key role in the process of recovery. In addition, the physiotherapist activated the patient's torso [9]. Thanks to NDT-Bobath therapy, contractures did not consolidate and muscle spasticity decreased.

Rehabilitation also involved the use of polysensory stimulation. Stimulation through auditory, olfactory, visual, gustatory and tactile stimuli provided the possibility of global and multi-sensory shaping of the given concept image. The patient's relatives were also involved in rehabilitation. The family tried to talk about



Figure 12. Patient during upright positioning – sitting down with lower limbs down [authors' image].

moments spent together and motivating the patient to fight for life. Ensuring a calm, supportive environment was of great importance: talking to the patient in a gentle voice, reading, informing him about every activity performed on the patient. Music therapy was also used by playing music he was known to like.

The patient, being comatose, did not show any activity or any ability to perceive. He did not respond to any stimuli. This condition lasted for about six weeks. After this time, small but noticeable signs of consciousness began to appear. Then we managed to make contact with the patient. He opened his eyes, began to show his first limb movements, and understood the questions asked, and articulated short, slow answers.

The positioning, exercises and neurophysiological methods still played an important role in the rehabilitation, which helped to avoid large distortions in the musculoskeletal system and assisted in the appropriate response. It was important to work in higher positions such as sitting down due to reduction of muscle tone, coordination and body posture. The key role was to work on endurance.

After the patient regained consciousness, prevention of breathing, swallowing and speech disorders became important. Starting early speech therapy was crucial as it helped to avoid the development of abnormal movement habits of the articulatory apparatus and non-physiological speaking habits. It also helped to eliminate drooling as well as lockjaw that could be a threat to the patient.

The next focus of the therapy was stimulation of memory, attention, perception, thinking and work on the emotional and motivational sphere. Short, simple instructions were directed to the patient to avoid situations where excessive information flow into the patient would result in confusion and gradual withdrawal from social interactions.

The patient is currently in the Opole Rehabilitation Center in Korfantów, where further rehabilitation was undertaken. Kinesiotherapy, physical therapy and rehabilitation pool exercises were introduced. Thanks to systematic rehabilitation, the patient has already started to take the first steps with the help of crutches. In addition, the patient attends occupational therapy and speech therapy classes.

## DISCUSSION

The described patient underwent early comprehensive rehabilitation, taking into account the patient's condition after multi-organ trauma. Various physiotherapy methods were used, such as passive exercises, positioning, respiratory therapy, classical and lymphatic massage, PNF method, the Bobath concept, and polysensory stimulation. In addition, music therapy was used. The patient's condition has improved significantly thanks to early and appropriate rehabilitation.

According to Arias-Fernandes et al., early rehabilitation in the intensive care unit is associated with an

increase in functional fitness and muscle strength, improved walking distance and a better perception of the quality of life related to health [10].

Mandel et al. believe that whilst undertaking physiotherapy during the time of regeneration and compensation, the type of therapy introduced and its intensity should be selected appropriate to the patient's current condition and the etiology of the disease. In order to achieve improvement in the functioning of the patient, rehabilitation should be carried out systematically. At a later stage, in addition to early management elements such as passive exercises and respiratory, special methods in physiotherapy, e.g., PNF and NDT Bobath methods, should be successively introduced. In the fight against spasticity, music and art therapies are widely used. Relaxation exercises are also important elements of therapy [11]. During work with the presented patient, therapists focused on multifaceted action and used most of the available methods in such cases.

The patient's big problem was muscle spasticity. Therefore, various physiotherapeutic and neurophysiological methods were used in therapy. Kalinowska and Kułak observed that in the fight against spasticity biomechanical aspects including movement therapy or kinesiotherapy, physical factors or physical therapy, chemical factors offered by pharmacotherapy as well as surgical methods should be taken into account. Such a large number of therapeutic methods ensures an individual therapeutic approach to each patient struggling with spasticity [12].

Music had a beneficial effect on the described patient. He heard his favorite songs. Bukowska and Konieczna in their research have proved that music therapy through its multifaceted activity is increasingly used in many branches of medicine, including neurology. It very effectively supports basic therapy in diseases or disorders resulting from damage to the nervous system and in the treatment of cognitive, movement and sensory disorders [13].

For a patient in a coma, it is important to connect with the environment, speak to him in a calm voice and inform about the activities performed. The case study presented by Tapson et al. shows the great power of conversation with an unconscious patient and proves that the sense of hearing functions in comatose patients [14].

## CONCLUSIONS

Early and comprehensive rehabilitation undertaken in a patient after craniocerebral trauma is extremely important and determines the effectiveness of therapy.

Comprehensive therapy and care are able to prevent a number of complications that threaten the patient as a result of immobilization.

The assumption that a comatose patient is unable to contact the outside world, but responds to stimuli, is fully correct. This concept allows the patient's family to be involved in the healing process.



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