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Case Report

Exploration of assistance and rehabilitation possibilities for neurosurgical patients with late complications after craniocerebral injuries based on one patient case

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ABSTRACT

Introduction: Craniocerebral injuries (CCIs) are the most frequent causes of death and long-term disability concerning people younger than 25 years of age in Poland. Their incidence is 180–220 per 100 thousand people. According to available data, 10% of patients after head injury suffer from severe craniocerebral trauma defined as a condition in which the level of awareness and responsiveness remains significantly decreased after resuscitation or worsens within 48 h following injury. Currently, due to the advances in knowledge and development of technology in the field of neurosurgery and anesthesiology, more and more patients survive and consequently require additional diagnosis, surgery and prolonged rehabilitation.

Aim: The aim of this work was to present the case of a patient with craniocerebral trauma, who remained in a vegetative state for 8 months, and then, following the surgical treatment of late complications in the form of hydrocephalus performed in the Division of Neurosurgery at the University Hospital in Olsztyn and long-term rehabilitation, regained full mobility.

Materials and methods: The study is based on the analysis of medical records concerning a patient treated in numerous centers for 16 months after craniocerebral trauma.

Results and discussion: The most common complications after CCIs include coma, impaired cognition, multiple joint contractures, hydrocephalus, ossification mainly related to hips, knees, shoulders and elbows, urinary tract infections and respiratory tract infections. Often these patients have undergone a tracheotomy, have had catheters inserted into their bladders, and are fed by probe. Inadequate care and a deficiency in protein and vitamin supplements can result in the development of decubitus ulcers. A patient after craniocerebral trauma requires intense movement rehabilitation, neuropsychological and neurologopedic rehabilitation. It is necessary to proceed appropriately in order to achieve bladder automaticity. After the stabilization of vital signs, the patient should be included in a comprehensive diagnostic and rehabilitation program provided by neurologists, neurosurgeons, orthopedic surgeons, ENT physicians, specialists in rehabilitation and physiotherapy, based on specified standards. Nurses and other care providers, medical and other

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health care personnel dealing with such patients should be adequately trained. The patient's family needs to be educated as well.

Conclusions: Patients after CCIs require long-term interdisciplinary monitoring and periodic diagnostic tests. Consequently, a long-term plan concerning the treatment of such patients should be developed.

1. Introduction

Craniocerebral injuries (CCIs) are one of the most frequent causes of death and long-term disability concerning people younger than 25 years of age in Poland. They are the major contributor of multiple organ injuries. CCIs are most frequent in males aged 15–24 years old. Their incidence is 180–220 per 100 thousand people annually. Out of this number, 15–30 per 100 thousand cases are fatal. The most frequent causes for CCIs include: traffic collisions (50%), falls (30%) and violence victims (10%). One of the major factors (40%) associated with such traumas is alcohol. Over 10% of patients after head injury suffer from severe craniocerebral trauma.[5,6] This condition is defined as a significantly reduced awareness and responsiveness immediately following the injury or within 48 h afterwards. CCIs accompanied with brain contusion, direct injury or quickly progressive hematoma are frequently associated with immediate focal brain injury. If compensatory mechanisms activated by the organism are insufficient or if therapeutic activities are not undertaken immediately, secondary pathological changes develop.

Primary brain injuries include: skull fractures, diffuse axonal injury (DAI), concussion, contusion, laceration as well as those associated with vessel injuries: subarachnoid hemorrhage, intracerebral hemorrhage, paracerebral hematomas.[4] Most frequently primary brain injuries result from a sudden acceleration or delay of force affecting a given organ. These injuries involve gray and white matter of the brain in immediate approximation of the area exposed to the external impact and, frequently, on the side opposite the area that was impacted as a result of hypotension (contrecoup injury). Brain areas at the highest risk of such mechanical injuries include: frontal poles, cranial basis, temporal poles, structures approximate to the cerebral falx and the tentorium of the cerebellum. The most significant brain injuries, especially involving white matter and brain vessels, occur when the head gets turned during the injury.[5]

The secondary brain injury is attributable to the organism's response to the primary or co-occurring injuries. Secondary brain injuries include: cerebral edema, decreased perfusion pressure, increased intracranial pressure (secondary brain herniation), hydrocephalus, central nervous system (CNS) infection, and posttraumatic epilepsy. Unlike in the case of the majority of primary brain injuries, discontinuing the development of the cascade of secondary changes early can stop or even in some situations regress symptoms associated with secondary brain injuries.[3]

CCIs cause late complications, usually in connection with irrevocable brain damage. The most frequent complications include: posttraumatic cerebrasthenia, posttraumatic encephalopathy, posttraumatic epilepsy, normotensive hydrocephalus – Hakim syndrome,[5,7] multiple joint contractures, periskeletal ossifications predominately involving hip and knee joints as well as shoulder and elbow joints, urinary tract and respiratory system infections. Considering the possibility of such complications, the treatment of patients after serious CCIs necessitates the cooperation of specialists in various medical fields, especially neurosurgery, anesthesiology and rehabilitation. Currently, due to the advances in knowledge and development of technology in the aforementioned fields, more and more patients survive and consequently require additional specialist diagnostics, neurosurgical interventions, treatment at intensive care units and prolonged rehabilitation.[8,9]

2. Aim

The aim of this work is to present the case of a patient with craniocerebral trauma, who remained in a vegetative state for 8 months, and then, following the surgical treatment of late complications in the form of hydrocephalus performed in the Division of Neurosurgery at the University Hospital in Olsztyn and long-term rehabilitation, regained full mobility.

3. Materials and methods

The study is based on the analysis of medical records concerning a patient treated in numerous centers for 16 months after craniocerebral trauma.

4. Results and discussion

A 59-year old male patient was admitted on 10 March 2009 to the Division of Neurosurgery due to posttraumatic normotensive hydrocephalus. The patient had a history of multiple organ injuries with a CCI resulting from a traffic collision (a cyclist knocked down by a car). The accident happened on 8 August 2008. On admission to the Emergency Department on the day of the accident the patient presented a moderately severe clinical condition, was cardiovascularly and respiratorily stable, and received a Glasgow coma score of 8. Cranial computed tomography (CT) revealed multiple brain contusions within the left frontal lobe, poles bilaterally and basis of the temporal lobes, small paracerebral hematomas above both hemispheres, multiple skull fractions in the right temporoparietal region, fracture of the right lateral orbital wall and the right zygomatic arch fracture. Moreover, chest

X-rays revealed multiple ribs fractures on the right side, right lung contusion, and the right shaft clavicle fracture. An interview obtained with the patient's family indicated that he had been treated for years for ischemic heart disease and hypertension. Since the accident, the patient had been treated in various centers due to numerous respiratory tract and urinary tract infections. The patient's neurological condition had not improved. On admission to the Division of Neurosurgery at the University Hospital in Olsztyn, the patient presented a moderately severe clinical condition, received a Glasgow coma score of 9, was cardiovascularly and respiratorily stable, without verbal contact, bed-ridden. The patient had spastic quadriparesis, with spasticity predominately involving the lower extremities, and a positive Babinski reflex on the right side. Bladder and bowel sphincter control was disturbed. Significant intellectual impairment was observed. The patient was unable to function independently. Medical documentation referring to previous hospitalizations contained information concerning a single episode of a simple epileptic seizure evolving to a generalized seizure. Nevertheless, a prophylactic treatment with valproic acid was introduced. In the sacrum region the patient developed a stage III decubitus ulcer. Since 6 November 2008, a gastrostomy had been placed, and a tracheostomy since 29 November 2008. Laboratory tests revealed normocytic anemia and decreased total serum protein. Cranial CT performed on 26 February 2009 showed dilatation of the ventricular system involving 4 ventricles (bifrontal index of 58%), malacia of both temporal lobes, cerebral falx calcifications, and condition after skull fraction involving the right temporoparietal region, fracture of the right lateral orbital wall and the right zygomatic arch fracture (Fig. 1). On the basis of the clinical picture and the cranial CT scans, the patient was diagnosed with normotensive hydrocephalus resulting from CCI and was qualified for surgical treatment.

On 11 March 2009, the patient received a ventriculoperitoneal shunt with the programmable valve system, with valve opening pressure of 110 mmH_2O. The surgery was complication-free (Fig. 2). Directly following postanesthetic recovery, improvement in the patient's neurological condition was observed. Within a few hours following the surgery, the patient regained a limited verbal contact with the surrounding environment. Bedside rehabilitation began on the first postoperative day. A gradual improvement with respect to logical contact was noticed daily, as well as a larger range of upper extremities mobility, and also lower extremities, but to a smaller extent. Gradually oral feeding was introduced.

On 23 March 2009, due to an improved condition of the patient, the tracheostomy tube was removed, and the gastrostomy tube 2 days later. As of 26 March 2009, the patient was fed only orally and to some extent he was able to eat on his own. A control cranial CT (2 April 2009) revealed a slightly narrowed ventricular system (bifrontal index of 41%) and a correctly placed drain in the right lateral ventricle (Fig. 3). Moreover, X-ray examinations of hip, knee and ankle joints were performed, which did not reveal abnormalities, apart from insignificant degenerative changes involving the right patella.

During hospitalization at the Division of Neurosurgery, the patient was consulted by a specialist in rehabilitation, and consequently deemed qualified for further treatment at the Department of Rehabilitation in another hospital in Olsztyn (MSWiA Hospital). The patient was transferred to the Department of Rehabilitation on 6 April 2009. Examinations performed on admission revealed spastic quadriparesis, flexion and extension contractures involving lower and upper extremities, extension deficits in the hip joints of up to 40° and in knee joints of up to 80°, coordination disorders, disturbed coherence patterns involving upper and lower extremities, deep sensibility disorders. The patient did not control his bladder and bowel sphincters, used diapers and had a urinary catheter inserted. In the sacral region there was a decubitus ulcer of 5×7 cm. Psychological examinations revealed a significantly disturbed verbal communication

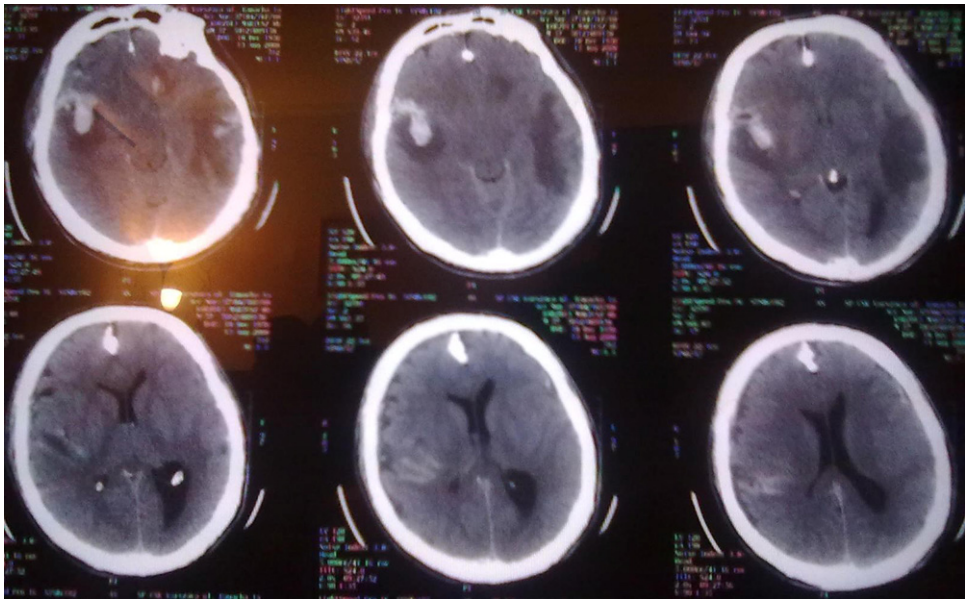

Fig. 1 – Cranial CT scan on the first day following the injury.

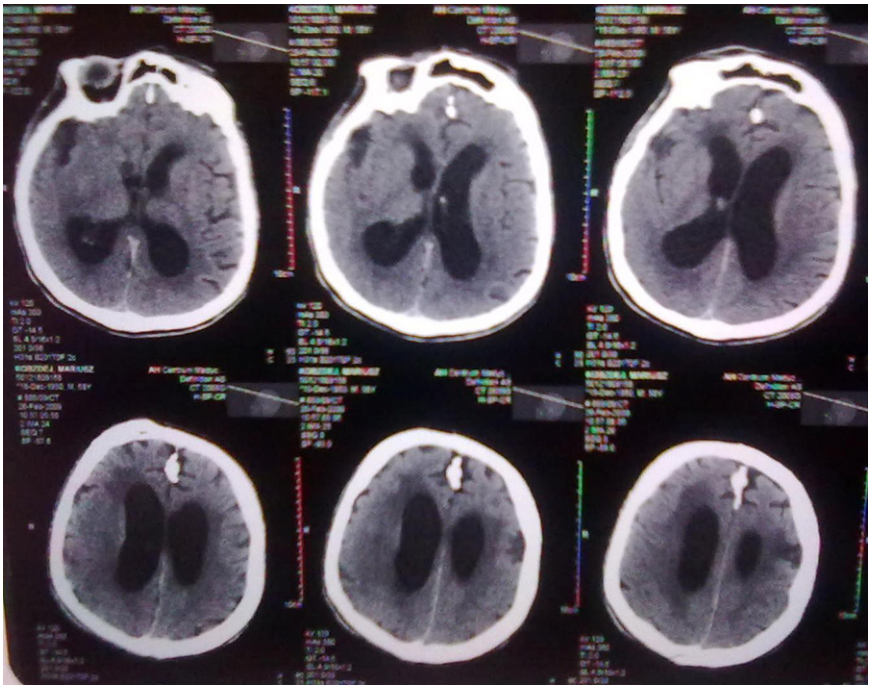

Fig. 2 – Preoperative cranial CT scan.

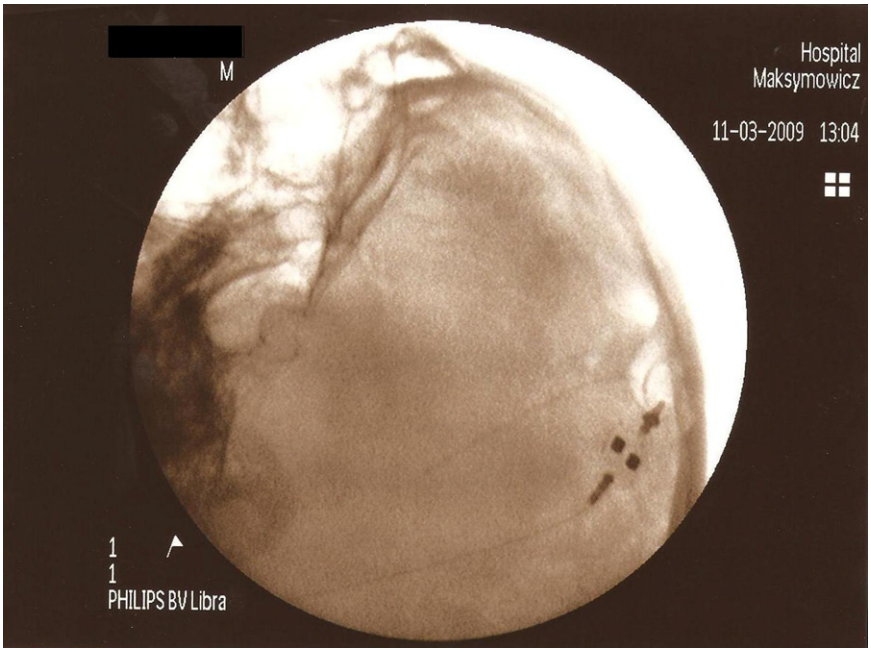

Fig. 3 – X-ray of the ventriculoperitoneal shunt to control valve opening pressure settings.

involving sentence coherence, absence of spontaneous speech, disturbed understanding of speech, disturbed spatial orientation, disturbed memory and cognitive functions. The patient was assessed as having a Barthel Index of 5, and also a score 5 on the Rankin scale, which meant that he required assistance in all daily activities. His rehabilitation comprised neurologopedic therapy, psychological therapy, kinesitherapy and physical therapy. Kinesitherapy initially involved breathing exercises, passive exercises combined with the elements of the Bobath method, tilting on a tilting table and assuming erect position in the parapodium. With reference to nursing, therapy according to the Bobath approach was employed to counteract spasticity. In order to prevent further formation of decubitus ulcers, the position of the body was changed every 2 h, combined with delicate tapping. As the patient's functionality improved, exercises consistent with the Bobath method were continued; progressively active slow exercises were introduced, followed by exercises with gradual resistance, self-assisted exercises, movement coordination and coherence exercises, and exercises according to the

proprioceptive neuromuscular facilitation (PNF) method. The catheter was removed from the bladder, and following the applied exercises normal miction was obtained. Physiotherapy included pneumatic massage of the lower extremities, polarized light and sollux lamp with a red filter targeting the decubitus ulcer, and pearl baths once the ulcer was healed. Spasticity remained a serious challenge, significantly hindering rehabilitation outcomes. Throughout the entire rehabilitation process, the patient was accompanied by his mother who mobilized him to become active again and read books to him.[1,2]

The patient remained at the inpatient Department of Rehabilitation from 6 April 2009 to 24 July 2009, and then continued his rehabilitation within the outpatient framework from 18 August 2009 to 2 September 2009 and from 26 October 2009 to 16 November 2009. The undertaken rehabilitation activities resulted in significant functional improvement, the achievement of complete independence, independent gait, assisted with a walking stick at longer distances, normal logical and verbal communication, the healing of the decubitus ulcer, complete control over bladder and bowel sphincters. Insignificant flexion contractures remained in the knee joint – extension deficits of 20°. The patient received the maximum score of 100 in the Barthel index and a 1 on the Rankin scale, indicating that he had become completely independent.

The most common complications following CCIs include coma, impaired cognition, multiple joint contractures, hydrocephalus, periskeletal ossifications mainly related to hips, knees, shoulders and elbows, urinary tract infections and respiratory tract infections. Often these patients have undergone tracheotomy, have had catheters inserted into their bladders, and are fed by probe. Inadequate care and a deficiency in protein and vitamin supplements can result in the development of decubitus ulcers. A patient after craniocerebral trauma requires intense movement rehabilitation, neuropsychological and neurologopedic rehabilitation. It is necessary to proceed appropriately in order to achieve bladder automaticity. After the stabilization of vital signs, the patient should be included in a comprehensive diagnostic and rehabilitation program provided by neurologists, neurosurgeons, orthopedic surgeons, ENT physicians, specialists in rehabilitation and physiotherapy, based on specified standards. Nurses and other care providers, medical and other health care personnel dealing with such patients should be adequately trained. The patient's family needs to be educated as well.

5. Conclusions

Patients after CCIs require long-term interdisciplinary monitoring and periodic diagnostic tests. Consequently, a long-term plan concerning the treatment of such patients should be developed.

Conflict of interest

None declared.

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