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Rehabilitation and nursing in children after hypoxic-ischemic brain injury — cases reports

Abstract

Children after hypoxic-ischemic brain injury are getting enlarge group of patients hospitalized in the department of Rehabilitation and Physiotherapy in Bydgoszcz. This kind of brain injury is one of the worst because it involves all neurons. The prognosis and physiotherapy progress without healthy neurons reservoir is unknown (opposite in mechanical brain injury). The after-effects of brain injury can be acute (early) and chronic (late). Medical care is often palliative procedure in this group of patients. Authors presents clinical, nursing and rehabilitation subject in children after hypoxic-ischemic brain injury. Multidirectional rehabilitation is necessary to start as soon as it is possible. The main aim of physiotherapy in this group of patients is to protect them from complications. The survival rate in children after severe brain damages depends on nursing care and proper rehabilitation.

Key words: hypoxic-ischemic brain injury, nursing care, rehabilitation, children

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Introduction

The central nervous system is extremely sensitive to hypoxia and ischemia. It is believed that after a 5-minute break in air flow and blood flow irreversible changes take place in brain cells. [1] The speed and effectiveness of undertaken resuscitation influences patients' fate. Acute hypoxia may result in irreversible coma, a vegetative state or akinetic mutism. In less severe cases the patients' state may improve gradually; however, long-lasting encephalopathy develops in most patients. [2] The structures that are most sensitive to hypoxia include: cortex, hippocampus, cerebellum and subcortical nu-

cleus (putamen and globus pallidus). Due to this reason, apart from paresis, the clinical image may also include: involuntary movements, convulsions, myoclonus symptoms of the Parkinson's syndrome or of the cerebellar syndrome. Hypoxic-ischemic brain injury rarely refers to children. The circumstances and reasons for injuries of the central nervous system, as far as children are concerned, depend on their age (Table 1). When it comes to the youngest patients it usually refers to the ill-treated child syndrome. However, older children are mostly injured during road accidents. [2] Such accidents constitute 30 percent of all injuries and the number is constantly increasing [3]. A hypoxic cerebral stroke is an extremely

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Table 1. Reasons for sudden circulatory arrest

| Mechanism of sudden circulatory arrest | Number of patients | Patient's age (years) | Sex |
|--|--------------------|------------------------------|-------------|
| Electrocution | 1 | 2 | M |
| Dysrhythmia | 1 | 13 | M |
| Strangulation | 2 | 15 and 16 | M |
| Reflex | 1 | 6 | M |
| Drowning | 4 | 1.5, 2, 4, 6 | 2 F, 2 M |
| TOTAL | 9 | Average age: 7.27, median: 6 | 7 M and 2 F |

rare illness concerning as the prevalence occurrence amounts to 0.63/10,000/year. [4] Nevertheless, the extremely severe cases include injuries caused by a sudden circulatory arrest. Patients who have suffered from hypoxic ischemic injuries require intensive care provided by doctors and nurses, proper feeding and early rehabilitation. Both correct positioning and preventing contractures belong to therapeutic actions and they should not be postponed until a patient is transferred to a rehabilitation department. Respectively, frequent changes of patients' positioning in bed, decubitus ulcers prophylaxis and protecting the trunk and limbs are all among necessary actions that are undertaken in departments of Intensive Medical Care. It is worth mentioning that even patients whose clinical state has not been stabilised yet or who require their life parameters being monitored may be admitted to a rehabilitation clinic.

Material and methods

During the period from 2004 to 2009 nine patients who have suffered from hypoxic ischemic injuries resulting from a sudden circulatory arrest were hospitalised in the Academic and Clinical Department of Rehabilitation of CM UMK in Bydgoszcz. The age of patients varied from 2 to 16 (average age 7.27). There were 7 boys and 2 girls. While in 2004, 2005 and 2006 only one patient was hospitalised, in 2007 two children, and in 2008 four children were hospitalised. The most numerous group was the group of children after a sudden circulatory arrest resulting from drowning, i.e. four patients, then two children after a suicidal attempt (through strangulation), one patient who was electrocuted, one after a sudden circulatory arrest of the Wolff-Parkinson's-White's syndrome and one child after a sudden circulatory arrest caused by aspiration of blood into airways which resulted from nasopharyngeal bleeding on the third day after tonsillectomy.

At the beginning all children were treated in the Intensive Medical Care Unit. Three of them were transferred to the Rehabilitation Clinic directly from Intensive Medical Care Units (from 6 to 8 month after injury), and six from neurological or neuro-rehabilitation (from 1 to 2 years from the injury).

As a result of severe damage done to the central nervous system three children were in a vegetative state when transferred to the Rehabilitation Clinic. They were diagnosed as having the intracerebral syndrome. As far as patients are concerned the following symptoms were observed: severe consciousness disturbances, vertical motor activity disorders, eyeballs and pupils' reactions disorders, vegetative dysfunctions, the so-called central autonomic dysfunction: tachycardia, increased arterial blood pressure, drenching sweat, thermoregulation disorders with temperature rises from 40 to 41°C, increased bronchial tree secretion. The patients presented mainly extensory spasms of the whole body, and two children positioned themselves in flexion synergy. All children were diagnosed as having spastic quadriparesis. Only two patients followed objects with eyes, communicated with their family, friends and medical staff by using extra verbal means.

All patients were evaluated according to GCS (Glasgow Coma Scale in English) at admission and discharge. We also evaluated the ability of verbal and nonverbal communication and presence of neurological deficits and muscle atrophy and contractures.

Detailed characteristics is shown in Table 2.

During hospitalisation one child required treatment due to a respiratory tract infection. Four children required directed antibiotic therapy due to a urinary tract infection. In one case it was caused by pathogens: *E. Coli* bacteria, *Klebsiella pneumoniae*, in the second by *Staphylococcus haemolyticus* MRCNS, *Corynebacterium* spp., and as far as other two children are concerned by culturing *Pseudomonas aeruginosa* in the urine.

Table 2. Characteristics of patients as far as rehabilitation is concerned

| Patients | ŁP | FJ | KP | PF | ZB | AK | MN | MK | SS |
|--|-----|----|----|----|----|----|----|----|----|
| Age in years | 1.5 | 2 | 2 | 4 | 6 | 6 | 13 | 15 | 16 |
| GCS when admitted | 4 | 3 | 7 | 4 | 9 | 9 | 11 | 7 | 11 |
| GCS when discharged | 4 | 3 | 7 | 4 | 11 | 9 | 12 | 7 | 11 |
| Spastic quadriplegia when admitted | + | + | + | + | + | + | + | + | + |
| Spastic quadriplegia when discharged | + | + | + | + | + | + | + | + | + |
| Extensory positioning of the body when admitted and discharged | + | + | + | + | - | + | - | + | + |
| Flexion positioning of the body when admitted and discharged | - | - | - | - | + | - | + | - | - |
| Maintained head control when admitted and discharged | - | - | - | - | + | - | + | - | + |
| Maintained trunk control when admitted and discharged | - | - | - | - | - | - | + | - | + |
| Maintained verbal contact when admitted and discharged | - | - | - | - | - | - | - | - | - |
| Maintained extra verbal contact when admitted and discharged | - | - | - | - | - | - | + | - | + |
| Muscular atrophy when admitted and discharged | + | + | + | + | + | + | + | + | + |
| Not fixed muscular contractures when admitted and discharged | + | + | + | + | + | + | + | + | + |
| Fixed muscular contractures when admitted and discharged | + | - | - | - | - | - | - | - | - |
| Symptoms of central autonomic dysfunction when admitted | - | + | - | - | + | + | - | - | - |
| Symptoms of central autonomic dysfunction when discharged | - | - | - | - | - | - | - | - | - |
| Convulsions in medical history | + | + | - | + | - | + | + | + | + |
| Tracheotomy tube when admitted and discharged | + | - | - | + | - | + | - | + | + |
| Gastronomy when admitted and discharged | + | - | - | + | - | + | - | - | + |

+ current; - none

None of the children had decubitus ulcers or pathologic fractures.

In the case of three children with symptoms of central autonomic dysfunction the actions undertaken in the first stage were aimed at stabilising them. In order to do that lytic mixture and non-selective beta blockers were administered. All patients were monitored and their water balance, electrolyte equilibrium and ionic balance were controlled. Moreover, prophylaxis aimed to prevent convulsions and acute stress ulcer, along with prophylaxis of the urinary and respiratory tract accompanied by treating accompanying illnesses was introduced. The patients were also administered neuroprotective medicine. Vegetative dysfunctions lead to an increased requirement of organism for energy. For this reason high-energy diet, enriched in dietary supplements and nutrients rich in protein such

as olive oil and products with cranberries (in order to acidify urine), was followed.

What is more, chest massage and positional drainage of the respiratory tract were introduced. Five patients that were hospitalised in the Clinic were equipped in tracheotomy tube which was changed every 2–3 days. Also normal saline inhalation was introduced. During their stay in hospital, no patients' clinical state improved to such a degree as to remove the tracheotomy tube. Patients who were found to have urine retention in the bladder were subjected to intermittent catheterization several times a day, with a break during the night, until an automatism of the bladder was created.

Rehabilitation, methods of therapy, intensity of therapy, the type used in the treatment and dose of therapy are always selected individual to the patient.

The above patients underwent neurophysiological rehabilitation: Vojta's method, Neuro-Developmental Treatment (NDT-Bobath) method and Proprioceptive Neuromuscular Facilitation (PNF).

In the case of patients admitted to our hospital presented signs of the vegetative storm. Improvement started from positioning of patients and placing them with an appropriate change of the body position every 2 hours. Patients were positioned as soon as possible. The procedure was done always under the control of heart rate and blood pressure. Then patients were treated with passive exercises and neurophysiological methods. Each patient was exercised from one to two hours daily. As the suppression of vegetative symptoms, in the therapeutic program were enrolled other physical procedures. At the beginning from 1 to 2 times daily during 10 to 20 minutes we enrolled hydro-massage and water-air massage of the entire body. Other physical treatments were selected individually depending on the neurological deficits

Other methods that were used included passive tilting of patients to erect position with the use of parapodium and tilting tables as well as hydrotherapy and/or cryotherapy or electrotherapeutic procedures such as tenolysis. Additionally, patients underwent magnetotherapy and phototherapy procedures. The above procedures were chosen individually and their function was to alleviate the symptoms. In order to prevent contractures means such as orthotics, helping equipment and Kinesio Taping were of great help.

Methods of treatment that are used in the Clinic include kinesiotherapy (and physical therapy) which is used simultaneously with logopedic therapy, including the Castillo Morales method. This method is based on an oral-facial regulatory therapy which is about stimulating muscles that take part in the speech process, facial muscles and oral cavity, respiratory and chest muscles, muscles that control the positioning of the head. The program is always chosen individually and it is adapted to patients' abilities.

Music therapy is also used. Patients listen to relaxation music for approx. 2 hours a day, with breaks, which was set at 5–8 Hz.

Patients stayed an average of six to 10 weeks during a single hospitalization at the Rehabilitation Clinic. Within one year each of the children described in the article were taken for rehabilitation treatment from 1 to 3 times.

During the children's stay in the Clinic patients' parents actively participated in the nursing and rehabilitation process. They are taught how to

perform basic nursing activities in order to take over nursing responsibilities at home once a child's clinical state is stabilised. They are also provided with psychological support.

All patients that were hospitalised in the Clinic were successfully stabilised which allowed them to be discharged home. An improvement of GCS scale was achieved in the case of two patients only. While the first patient's result improved from 9 to 11, the second one's improved from 11 to 12. Unfortunately, a significant improvement of the neurological state was not achieved. All patients required full-time nursing care provided by the medical staff and their family. Children's parents, once they were given instructions, learnt how to perform basic nursing activities and could take care of their child at home.

Patients' stay in the Clinic took approx. from 6 to 10 weeks during a single hospitalisation. Throughout the year each child was admitted from 1 to 3 times.

Discussion

Although both pathology and the mechanism of damage in the central nervous system are better examined they still characterise themselves with high mortality. The findings that were made until this day do point to any medicine as being better than other as far as a significant influence on improving the prognosis or decreasing brain damage is concerned [5]. The research that is being done and which concerns using Galantamine, Donepezil and Rivastigmine showed a subjective improvement in concentration, yet this effect was not confirmed as far as a patient after severe craniocerebral injury was concerned [6, 7] There is information that Choline Alfoscerate, a direct precursor of Acetylcholine which plays a role in the functioning of memory and emotions and of Dexamphetamine Sulphate which stimulates the cerebral cortex, is being used to minimise secondary results of the injury [8–12]. New methods of treating patients who suffered from damage in the central nervous system are constantly being sought after. Some institutions advise using hypothermia when it comes to adult patients with GCS 4–7 pts maximum 3 hours after the injury. Such trials were performed on the youngest patients. Children were being cooled down to a temperature of 32.5 °C for 24 hours, but, unfortunately, it turned out that such therapy does not only influence a patient's neurological improvement, but also adds to a higher mortality rate [15].

When analysing literature one may notice that 70–90% of patients who have suffered from severe brain damage and received less than 8 points on

the GCS scale were diagnosed with a persisting vegetative state or death [5]. At the same time, research done by Aiksis and partners, Kelly and Becker, Kirkpatrick and partners suggests a decrease in the percentage of deaths and an improvement of the survivability ratio as far as patients with severe head injuries are concerned [13]. Thanks to a development of medicine in the scope of first-aid service and intensive medical care an increasing number of patients, also after an ischemic brain injury, is more likely to survive. However, such injury very often leads to severe consciousness disorders. This unquestionable success of medicine is connected with the need to provide nursing and rehabilitation care for those patients. As there are no standards determining therapy-related actions in the said group of patients subsequent dilemmas arise: how fast and to which extent can rehabilitation treatment be undertaken, how long should it last?

According to Hoffman and von Wild [2002] rehabilitation is an integral part of intensive medical care once a patient's state and needs are taken into consideration [13, 14]. That is why, following the stabilisation of the clinical state, rehabilitation should be introduced as early as possible.

Rehabilitation, methods, intensity of therapy, types of procedures and frequency of introducing them is chosen individually for each patient. The rehabilitation process is governed by the following rules:

- early rehabilitation;
- systematic treatment activities;
- the main purpose of actions should be to reduce existing disorders;
- following the model of neurophysiological rehabilitation, i.e. stopping persisting reactions and stimulating correct physiological reactions;
- twenty-four-hour nursing care which is in accordance with the rules of neurophysiology;
- providing patients and their families with support of a psychologist and a clergyman.

Such attitude conditions cooperation of all doctors, including consultant doctors, in the rehabilitation process: neurologists, neurosurgeons, laryngologists, urologists, nurses, dieticians and therapists such as physiotherapists, neurologopedists, neuropsychologists, activity therapists and an orthopedic equipment technician [13].

Conclusions

1. Even though specialised rehabilitation was introduced early, satisfying therapeutic results were

not observed as far as 6 children are concerned. Neurological state did not improve. Only two children improved their GCS rating: from 9 to 11 and from 11 to 12.

2. An improvement of the neurological state of two children was mainly due to early resuscitation which reduced the scope of damage done to the brain. This enabled a mobilisation of the plasticity compensatory mechanisms of the central nervous system.
3. Neurological condition improved among two patients achieved thanks to early and specific rehabilitation, which allowed for the mobilization of the compensatory mechanisms of plasticity of the central nervous system. Not without significance is the fact, that patients with early you started CPR at baseline had less neurological deficits
4. According to observations, feeding through a PEG stomach tube is a better solution than using intragastric feeding through the nasal foramen. Such tube makes the return of palatine and pharyngeal reflexes more difficult. It is also an obstacle during logopedic therapy and it prolongs the return of palatine and pharyngeal reflexes.
5. Intensive specialist rehabilitation is of tremendous importance during the period of the first 3 months after the accident, till about a year. If no minimum improvement in the neurological state is achieved by then it is highly likely that the patient will remain unconscious and the prognosis is bad. Such patients will require intensive palliative care.
6. The rehabilitation process should be an integral element of treating patients who have suffered from a central nervous system injury. Intensifying the rehabilitation process is possible only when the vegetative state is stabilised.

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