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THE ROLE OF HYDROKINETOTHERAPY IN IMPROVING THE DAILY LIFE OF ADOLESCENTS WITH SPASTIC TETRAPAREZIA

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Abstract: *This theme is represented by a neurological field, being the main cause of mortality worldwide. It appears at any age and still remains the abstraction that comes first and is very important and very common globally. The condition cannot be completely cured, as other impairments such as hemiparesis, hemiplegia, paresis and paraparesis appear afterwards. The essence of the article is the realization and establishment of recovery programs for infantile spastic tetraparesis in order to recover and put into operation some important functions of the body.*

Key words: *hydrokinetic therapy, spastic tetraparesis, adolescent.*

1. Introduction

Infantile cerebral palsy is characterized by a group of disorders of motor development and posture, which limit the activity that causes non-progressive dysfunctions that occur in fetal or child development.

These motor-type disorders are accompanied by sensory, perceptual, cognitive, communication, epilepsy and secondary musculoskeletal disorders [1].

This clinical form of infantile cerebral palsy is the most severe, often associated with microcephaly, epilepsy, blindness and mental retardation. Compared to spastic diplegia, here the upper limbs are more affected, and often walking is impossible and often depends on the child's intelligence.

In infantile spastic tetraparesis we have the following main characteristics:

- presents pyramidal semen in all body parts;
- the upper limbs are permanently flexed;
- mental retardation with speech disorders;
- signs of delay in neuromotor development appear;
- in the lower limbs contractures appear at the level of adductors and accentuated equine foot;
- the tonicity of the extensor muscles a
- spine, is not developed.

Progressive infantile spastic tetraparesis

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spans a broad spectrum of partially rare differential diagnoses. Based on a clinical example, differential diagnostic considerations are discussed in detail [5].

2. The peculiarities of the spastic tetraparesis

2.1. Elements of physiopathology, muscle tone, muscle trophicity and reflexes

a) Elements of physiopathology

The pathophysiology represents the type of neurological manifestation that has a well-defined correspondence from the point of view of the lesion location.

Apart from these aspects, however, which are rarely presented in their pure form, where there is a common background, which consists in the interfacing of inhibitory mechanisms.

Whether the lesion is on the cortex or at a lower level, it causes a disruption of the inhibitory function that the cerebral cortex and subcortical structures have on muscle tone and higher reflex postural activity [6].

b) Muscle tone

It is the semi-contraction situation in which a muscle is found in a state of rest, it is summed up in an activity of reflex origin, an act that ends at the level of the marrow. Any reflex has a receptive element, efferent pathways, receptive element and effector element.

The receptor element is made up of muscles and consists of structures specially made up of the neuro-muscular spindle, parallel to the striated muscle fibers.

The neuromuscular spindle consists of a fusiform body 0.75-4 mm long and contains 3-10 intrafusal fibers surrounded by a capsule of connective tissue, leaving the anterior horn.

The medullary regulatory and effector system of muscle tone guarantees functional suppleness and permanent adaptation to the needs of posture, gestures and behavior towards the external environment.

Muscle hypotonia highlights the increase in amplitude; the hypotonia muscle loses its relief, which then becomes soft to the touch, slightly depressible. It occurs in lesions of the tonic reflex arc, lesions of the supramedullary centers have a strengthening reaction on muscle tone and in lesions of the central motor neuron.

Muscle hypotonia is achieved by damage to the central motor neuron due to the suppression of the moderating action of the centers on muscle tone.

Hypotonia can be a confusing clinical presentation, often leading to unnecessary investigations. Gradual and accurate assessment is very important to arrive at the correct diagnosis [4].

c) Muscle trophicity

It is maintained by the peripheral motor neuron cell, the disease leading to muscular strophy, which is manifested clinically by the shrinking of the muscle, where the relief disappears and the respective region is deformed.

Apart from those mentioned above, we also encounter muscle atrophies due to primitive myopathies.

Secondary and deuteropathic atrophies divided into: myelopathic atrophies in motor neuron cell lesions and fast-walking myelopathic atrophies.

Propathic muscle atrophies are chronic muscle diseases, which are characterized

by muscle atrophies with a special topography, they differ from neuopathic ones by several characteristics:

- they start in childhood or adolescence, they went slowly and progressively.
- more frequent in males
- involves the proximal musculature of the limbs, belts and the rest
- they are symmetrical.

Secondary axonal atrophy is common in most if not all demyelinating neuropathies and is likely responsible for most of the clinical symptoms [2].

d) The reflexes

A motor, secretory response is admitted by reflex, it is divided into conditioned and unconditioned. Conditioned reflexes are acquired during life, temporary and have their center in the cerebral cortex, and unconditioned reflexes are innate and have their center in the lower floors of the nervous system.

Somatic reflexes: extension reflex, flexion reflex, cross extension reflex. And osteotendinous reflexes are produced using an L- or T-shaped reflex hammer. Reflexes are an essential part of protective and homeostatic function [3].

2.2. The positive diagnostic procedure

In neurology, the diagnosis of infantile spastic tetraparesis is made by obtaining very important anamnesis data, starting from the causes on the part of the mother and the fetus. Carrying out the interrogation of the mother and the child is a very concrete one; it provides the main elements of the clinical diagnosis. After this stage is verified, a well-established plan is based on which the environment in which the child develops is investigated as correctly as possible. The general and neurological examination consists in the discovery of signs and symptoms concerning the body and the nervous system.

The paraclinical stage is the most important because it has a role to confirm the hypothesis of the clinical diagnosis.

2.2.1. Psychomotor development of the child:

- Evolution of the disease: date of onset, conditions in which it occurred;
- Examination of the newborn, infant, child;
- The child's parameters at birth and their evolution (weight, waist, cranial perimeter).

2.2.2. Neurological assessment:

This type of assessment consists of the child's development in all areas of the body, such as:

- From the point of view of cognitive function;
- From the point of view of language;
- From the point of view of socialization;
- From the point of view of gross and fine motor function;

After the first part of the assessment, we find out whether the quadriplegic child can fit into the daily activities from a functional point of view (feeding, body hygiene, and dressing) and at the same time the cranial nerves, muscle tone, osteotendinous reflexes, postural reactions, trunk, neck and posture are evaluated. All these neurological assessments are performed from all positions (ventral, lateral, walking, and biped, sitting).

2.2.3. Complications and evolution

As complications in the diagnosis of spastic tetraparesis, it can occur and affect

certain functions, systems and devices of the body. Due to the etiological factors that appear from the first month of the fetus, we can encounter certain massive complications at the birth of the child and throughout its life, for example:

- Orthopedic complications
- Complications metabolic function
- Digestive tube complications
- Cognitive disorders
- Eye complications.

A first orthopedic complication appearing in the child with spastic tetrapresis is that of subluxation at the level of the hip joint, which appears from an early age.

Complications from the level of metabolic function in the child with spastic tetraparesis can turn into a hereditary neuropathy.

Complications in the digestive tract can appear from an early age, because in the first stage of the digestive tract, a chewing process takes place in the oral cavity. Many of the children with spastic tetraparesis have an eye problem, being ophthalmologically diagnosed with strabismus and ocular atrophy. Many of the children are at risk of losing their sight and cannot make connections that contain images with specific information from the environment. Cognitive disorders in the child with spastic tetraparesis appear in the form of mental retardation, which is more severe (IQ below 50) and mild (IQ above 50) [6].

2.2.4. Therapeutic options

To treat infantile spastic tetrapresis in a child, we can use the drug route or using physical therapy. Physical therapy represents a part of the functional recovery of the child with spastic inflatable tetraparesis, using factors from the biological environment and procedures specific to this condition.

Methods of spastic tetraparesis recovery in several ways:

- Orthopedic means (use of splints and cast devices for affected body segments)
- Hydrokinetotherapy (use of active and passive exercises in water to reduce spasticity)
- Massage (using techniques to improve blood circulation and lymphatic drainage)
- Stretching techniques
- Proprioceptive neuromuscular facilitation techniques

The medicinal part of the quadriplegic child shows us that the medication has only a secondary role and that its modest effects are only observed in relatively mild forms.

3. Material and Methods

The research study intended for individuals with spastic tetraparesis was carried out in the Swimming Pool of the Municipal Sports Club in Târgoviște, during 9 months, it being equipped with specific material for hydrokinetotherapy, but also adaptations in terms of the accessibility of the pool for people with special needs.

This recovery activity started on 1.05.2022 and ended on 24.02.2023, the group being made up of three people diagnosed with infantile spastic tetraparesis.

The hydrokinetotherapy program that took place in the swimming pool took place every day of the week except for Saturday and Sunday, 60 minutes each, each having an individual hour for carrying out the recovery activity.

3.1. Patient record

The target group participating in this hydrokinetotherapy program consists of 3 individuals diagnosed with infantile spastic tetraparesis, the group consisting of two boys and one girl.

The three subjects come from the urban environment, where the involvement of the parents through different methods of recovery and investigation from a very young age contributed a lot to physical and mental development, but also to prolonging life.

The subjects come from families with good economic potential, they take part every week in physical therapy sessions, therapeutic swimming, adapted gymnastics, hydrokinetotherapy and various therapies beneficial to the body, psychological counseling sessions, with the involvement of the parents.

3.2. The research plan

The research is carried out on the basis of four important research stages, with the main objective being the design of hydrokinetotherapy programs. The four stages of the research are presented as follows.

In the first stage of the research, the specialized literature specific to the topic addressed was studied.

In the second stage of the research, individuals with infantile spastic tetraparesis were selected, where individual files were drawn up with data on the general anamnesis.

In the third stage of the research, hydrokinetotherapy programs were created and we applied them with the help of therapeutic exercises.

In the last stage of the research, the evolution of each individual was assessed.

To carry out and form a recovery program, we must follow certain principles that underlie the recovery movement.

We have the following principles:

- Accomplishing a static adaptation, balance, affected muscles, prehension and posture;
- Exercising according to different static, fundamental, relaxation, aerobic, apnea and order exercises;
- Making passive and active movements;
- Avoiding fatigue, focusing on breathing exercises.

The research is based on the following aquatic therapies along with therapeutic exercises, which will be applied to each individual case.

3.3. The aquatic gymnastics-exercises

It is the most common method of hydrokinetotherapy that we use in this study, because it is based on movements and exercises specific to learning to walk, but also improving it.

This method will be done every session for 20 minutes, because it relies on specific movements to correctly achieve the goals in this program. The benefits of this method are the improvement of walking, posture, balance and respiratory function:

1. Exercise represented by release in the aquatic environment - The individual must perform dives and movements as independently as possible, without the help of the physiotherapist, figures 1 and 2.

Fig.1. *Individual dives at the edge of the pool*

Fig.2. *Group diving at the edge of the pool*

2. The exercise represented by balance in immobility - From the supine position on the surface of the water with the upper limbs located in the sagittal plane, the individual must perform floating on the back, figures 3 and 4.

Fig.3. *Process back to individual form*

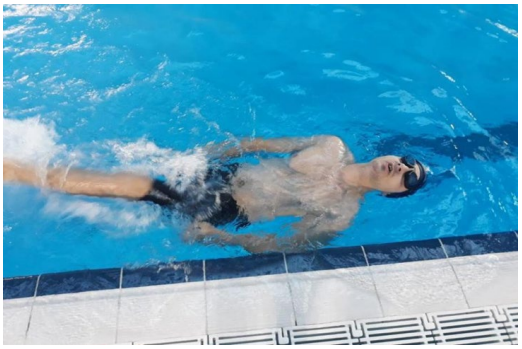


Fig.4. *The back process in individual form*

3. The exercise represented by the sliding floating device - From the supine position on the surface of the water, the individual will have to float on his back, and the physical therapist will have his hand on the back of the subject's neck, the role of this exercise is to give the individual confidence in the aquatic environment figure 5.

Fig.5. *Assisted group back process*

4. Results and Discussions

Following the case study carried out during the 9 months, hydrokinetotherapy methods were applied for the purpose of recovery, re-education and prophylactic some aids specific to the aquatic environment, having a number of 3 subjects with the diagnosis of spastic tetraparesis.

The application of the hydrokinetotherapy program was carried out on the basis of compliance with the objectives, goals, hypotheses, tasks, research methods, doctors' recommendations, methods specific to the aquatic environment, but also on the basis of evaluations.

Following the hydrokinetotherapy program applied to patients with spastic tetraparesis, we discovered from the beginning of the case study that they presented balance, breathing, spasticity, mobility, range of motion and muscle tone problems.

In the first part of the program in the aquatic environment, a lot of emphasis was placed on relaxation, positions (standing and sitting) and gradual getting used to the dry environment, using the playful method for a more gradual approach.

In the first month of the case study, the clinical picture of the patients was evident with an increased spasticity, reduced mobility, imbalance, counteraction of the hip adductors and walking deficit, making it difficult to carry out the hydrokinetotherapy program.

In order to reduce and solve these difficulties, the patients have been subjected to therapeutic swimming, water gymnastics, aquastretching, passive mobilizations and the Hallwich method, having a role in ameliorating these difficulties.

Having progress as results since the 3rd month, the result being the improvement of floating on the back and face, breathing has improved, coordination and movement of the upper and lower limbs on the surface of the water without help has been regained.

After the program, it was found that the evolution from the 4th month was the improvement of walking from all positions, running in the water. These exercises in the recovery program made the individuals walk and manage their daily activities.

4.1. Research-specific evidence

a) The method of evaluating spasticity using the Ashworth scale.
b) Balance method Romberg test

a) The method of evaluating spasticity using the Ashworth scale

Table 1

The results when measuring the degree of spasticity

Subjects	T1	T2	T3
S1	1	2	4
S2.	1	3	4
S3	1	2	4

b) ***Balance method Romberg test***

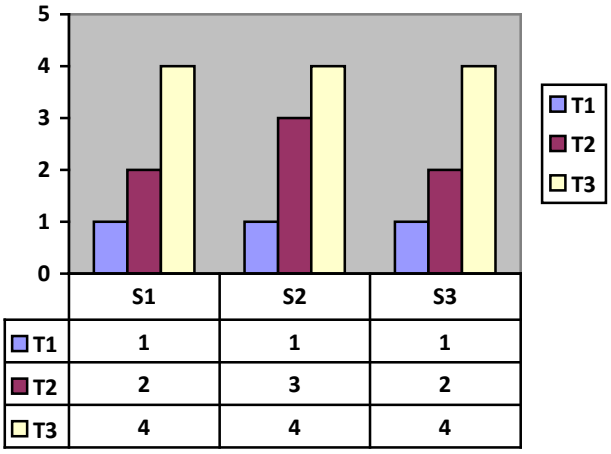
Table 2

Romberg Test results

Subjects	T1	T2	T3
S1	Negative	Medium	Positive
S2	Negative	Medium	Positive
S3	Negative	Medium	Positive

a) In figure 6 we can see that at the beginning of the evaluation the patients had a slight hypotonia with minimal resistance, so that at the end of the recovery we reach a considerable increase in muscle tone with difficult passive movement.

Recovery of people with tetraparesis during puberty in the aquatic environment, using specific methods, must represent a process from the point of view of static function, cognitive function, and mobility, movements performed in the aquatic environment, coordination and social inclusion.



	S1	S2	S3
T1	1	1	1
T2	2	3	2
T3	4	4	4

Fig. 6. *Spasticity degree values subjects*

b) In figure 7 the assessment of the balance of the patients who had to perform the balance test have registered considerable increases with a rapid transition to the maximum balance threshold.

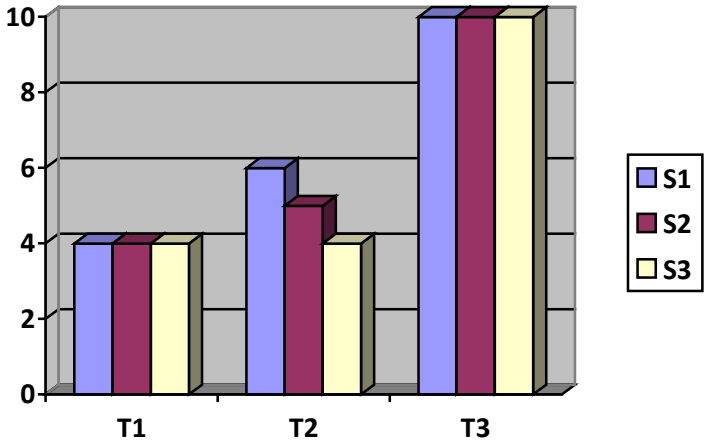


Fig.7. *Subject balance degree values*

At the end of the 9 months of recovery, the patients were subjected to the same balance test to see the results of the recovery, they had 100%, that is, the patients passed the test due to the hydrokinetotherapy.

3. Conclusions

In conclusion, we can say that infantile spastic tetraparesis is one of the most serious extrapyramidal lesions of the system, because it affects the entire body.

For the recovery of these people with spastic tetraparesis, several methods must be used for recuperative and prophylactic purposes, because the use of a single method is not effective and can cause more harm [7], [8], [9].

The recovery of persons with tetraparesis during puberty in the aquatic environment, using specific methods, must represent a process from the point of view of static function, mobility, movements performed in the aquatic environment, coordination and social inclusion [10].

As a final conclusion, we can demonstrate through the results obtained from the hydrokinetotherapy program for people with tetraparesis, that the improvement of the quality of life increased a lot, using these long-term hydrokinetotherapy methods, because the individuals started to make progress on the motor level.

References

1. Avramescu, E.T.: *Physiotherapy in pediatric conditions.* Craiova, University Medical Publishing House, 2007, p. 20-24.
2. Hanemann, C.O., Gabreels-Festen, A.A.W.M.: *Secondary axon atrophy and neurological dysfunction in demyelinating neuropathies.* In: Current opinion in neurology. Vol. 15(5), 2002, p.611-615, DOI: 10.1097/00019052-200210000-00012.
3. Hunyor, A.P.: *Reflexes and the eye*. In: Australian and New Zealand journal of ophthalmology, Vol. 22(3), 1994, p.155-159, DOI: 10.1111/j.1442-9071.1994.tb01710.x.
4. Jan, M.M.M.: *Infant Hypotonia*. In: Manual of child neurology: problem based approach to common disorders. Bentham Science Publisher, Saudi Arabia, 2012, p.83-86.
5. Kuehnlein, Sperfeld, A.D., Gdynia, H. J.: *Differential diagnosis in progressive infantile spastic tetraparesis*. In: European journal of medical research, Vol. 13(10), 2008, p.447-450.
6. Robănescu, N.: *Rehabilitation of the physically handicapped child*. Bucharest, Medical Publishing House, 1976, p. 12, 30-31, 84-90.
7. Sena, G., Gallo, G., Vescio, G. et al.: *Anti-Ri-associated paraneoplastic ophthalmoplegia-ataxia syndrome in a woman with breast cancer: A case report and review of the literature*. In: J. Med. Case Rep. BioMed. Central Ltd., 2020, p. 1-5.
8. Stauss, T., El Majdoub, F., Sayed, D., et al.: *A multicenter real-world review of 10 kHz SCS outcomes for treatment of chronic trunk and/or limb pain*. In: Ann Clin Transl Neurol, Vol.6, 2019, p. 496–507. doi.org/10.1002/acn3.720
9. Wagner, M., Levy, J., Jung-Klawitter, J. et al.: *Loss of TNR causes a nonprogressive neurodevelopmental disorder with spasticity and transient opisthotonus*. In: Genetics in

Medicine, Vol. 22, Issue 6, 2020, p.1061-1068. doi.org/10.1038/s41436-020-0768-7

10. Woods, E., Spiller, M., Balasubramanian, M.: *Report of two children with global developmental delay in association with de novo TLK2 variant and literature review*. In: American Journal of Medical Genetics Part *A*, 188A, 2022, p. 931–940. doi.org/10.1002/ajmg.a.62580