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The effect of hippotherapy on postural balance

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ABSTRACT

Introduction. Impaired motor control in children with infantile cerebral palsy (ICP) frequently leads to mobility limitations.

Aim. The aim of the study was to assess the effect of hippotherapy on maintaining postural balance and gait in children with ICP.

Material and methods. A total of thirty children with spastic diplegia, aged 8-13 years, participated in the study. All children took part in a two-week hippotherapy program. The Tinetti and Timed Up and Go (TUG) tests were used to investigate the quality of their postural balance and gait. All tests were performed before and after therapeutic horseback riding.

Results. After the two weeks of therapy, a statistically significant ($p < 0.05$) improvement in balance maintenance and gait performance was observed in all children.

Conclusion. 1. Hippotherapy sessions significantly improved the level of postural balance in children with ICP.

2. Equine-assisted therapy (EAT) positively affected the quality of gait and significantly decreased the risk of accidental falls in children who participated in the rehabilitation program.

Keywords. cerebral palsy, hippotherapy, balance

Introduction

Rehabilitation of children who suffer from infantile cerebral palsy (ICP) constitutes one of the core elements in the therapeutic process. ICP is one of the most frequently prevailing paediatric neurological disorders which present challenges to physiotherapists. Due to the above-mentioned disorders, new methods supporting the process of revalidation of this dysfunction are sought for. ICP is not a disease; it is rather a set of symptoms resulting

from a brain injury in pregnancy, labour or the perinatal period. A diversity of symptoms accompanying ICP, mainly disturbances of maintaining postural balance during movement, may result in chronic muscle imbalance and lead to increased disability with age. Impaired postural control belongs to one of the most serious locomotion problems of children with ICP which cause limitations in performing everyday activities.¹ That is why the process of treating persons with ICP requires a diverse

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attitude, and the main target of rehabilitating impaired locomotion should consist in improving motor skills and accomplishing the best possible functional independence of those persons through increasing their control of locomotion and posture. Rehabilitation of a child with ICP should commence as soon as possible, and it should be conducted in a complex way, taking into account its subsequent developmental phases.^{2–4} Many various methods and treatments, modified and improved over the years, are used in rehabilitating children with ICP, e.g. neurophysiological methods, such as the NDT, Vojta method or a sensory therapy, through which the greatest possible level of functional independence of a child participating in the rehabilitation program is expected.^{5,6} Hippotherapy belongs to one of the rehabilitation methods with a multipurpose, interdisciplinary approach. Equine-assisted rehabilitation of disabled persons should also comprise other areas of medicine and rehabilitation, including psychology, pedagogy, hippology, hippotherapy, physical culture and horse riding.^{7,8}

Hippotherapy affects physical, cognitive, social, mental, and behavioural and communication spheres and that is why it is used to rehabilitate persons with ICP, Down syndrome, autism, multiple sclerosis and traumatic brain injury, muscular dystrophy and postural deformities, difficulties in learning and in sensory disturbances. It is a therapeutic method successfully used in children, and according to the 2009 data of the Polish Central Statistical Office, there were more than 180,000 disabled children in Poland, out of whom every third child experienced locomotion problems.^{9,10}

Hippotherapy encompasses activities which target at restoring fitness and health by interactions with horses and by horseback riding. Different movements of the horse present challenges to the rider to promote different postural responses, which among others affect their muscle tone, control of the head and neck posture, postural balance, stability of the trunk and performance of the limbs. The above-mentioned physical benefits of therapeutic work with horses are possible thanks to the:

- pelvic movements of the horse while walking, which are similar to the pelvic movements of a man during a leisurely walk
- length and the number of steps performed by a horse per minute, which are similar in length and the number of steps of an adult man
- temperature of the horse's body, which is 37.5°C–38.5°C, and affects restoration of normal muscle tone
- and repetitive, rhythmic movements of the human body while riding a horse, which stimulate hormonal secretion affecting stimulation of the vegetative system.¹¹

The rider's reception of motor stimuli caused by the rhythmical gait of a horse and their responding to them

are the main targets of hippotherapy sessions. According to Strumińska, the general aims of hippotherapy include the stimulation of the psychomotor development of the child, i.e.: improvement of the eye-hand coordination, development of self-reliance and the ability to maintain organised activity and to focus on given tasks, improvement of locomotion, a decrease in postural balance disturbances and improvement of defensive reactions, relaxation and weakening of neurotic reactions and an increase in high self-esteem.¹²

Therapeutic effects caused by the horse gait were confirmed by many research projects.^{7,13,14}

Aim of the study

The aim of the study was to assess the quality of postural balance and gait in children with ICP who participated in the hippotherapy program.

Material and methods

A total of 30 children, including 19 girls and 11 boys, with ICP (the spastic diplegia CP) within intellectual norm participated in the study. Participant age fell within the age bracket of 8–13yrs. Children, based on a physiatrist's recommendation, were qualified for hippotherapy sessions. Participants were included in the study group based on the following criteria: suffering from a mild form of *hemiplegia spastica* or *diplegia spastica* of ICP, medical certificates from orthopaedists or neurologists confirming the lack of contraindications against hippotherapy, possibility of independent locomotion and communication. Children with severe ICP and those with intellectual disability making communication impossible were not qualified for the study. All 30-minute hippotherapy sessions were conducted daily from Monday to Friday by a highly qualified therapist at the Hippotherapy Centre in Stróże, and the therapeutic horseback riding program lasted for two weeks. Tests and the equine-assisted therapy were conducted in March 2016. During the two week hippotherapy program children did not participate in any other therapies. Participants' parents and legal guardians gave their informed consent for the participation of their children in the study.

The following research tools were used in the study.

The Timed Up and Go Test (TUG) to assess dynamic balance and the risk of accidental falls. The mobility test consisted in performing specific motor activities, such as standing up from a sitting position on a chair, walking for 3 meters, turning back and covering the same distance back to the chair and sitting down on it. The time of performing the task correctly was taken as the test score. Participants were assessed according to the protocol modified for the needs of persons with ICP, i.e.: commands were repeated several times during the performance of the test, the chair used in tests was equipped with a back rest but it did not have arms, the measuring

of the time did not commence at the moment of hearing the “get ready and go!” command but at the moment of raising buttocks from the chair, and it ended when the participant sat back on the chair.

The test was conducted three times and the attempt with the shortest time in seconds was recorded in the test chart. The path of the walk was three metres long and it was marked by the starting line before which a chair stood, and the finish line behind which the participant was supposed to turn back and return to the chair. The participant sat on the chair before commencing the test. At that time a physiotherapist explained the task to them, demonstrated its performance and conducted a preliminary attempt to verify whether the task performance had been understood.

Balance and gait quality were assessed by means of the Tinetti test, which consisted of two parts. Part one assessed postural balance and included nine tasks: 1) maintaining balance in a sitting position on a chair, 2) standing up, 3) an attempt at standing up from a sitting position on a chair, 4) maintaining balance immediately after assuming a standing position (for the initial five seconds), 5) maintaining balance while standing, 6) pushing (the participant stood with their feet kept as close together as possible, and the physiotherapist delicately pushed them by nudging the participant’s chest three times with their palm), 7) a pushing test in standing with the eyes closed, 8) turning around 360 degrees, and 9) sitting down.

The maximum score in the balance test was 16.

The gait part of the test consisted of seven parts and assessed the following: 1) the gait initiation (once the command was heard), 2) the length and height of the step, 3) the symmetry of the step, 4) the step flow, 5) the path of the gait (assessed within the distance of approximately 3m; a deviation of 30 cm was recorded), 6) the trunk posture (it was checked whether the participant wobbled while walking), and 7) the foot placement when walking (heels wide apart or touching).

The maximum score in the gait test was 12 points. The final result consisted of the score for each section of the test and the overall test score.

Statistical analysis

The statistical analysis of the results was conducted by means of Statistica v.10. The Shapiro-Wilk test was used to assess distribution of the variables under analysis. Because the variables met the criteria for a normal distribution, the significance of differences was assessed by means of the t-Student test for dependent samples. The level of significance was accepted at $\alpha = 0.05$.

Results

Based on the statistical analysis of the Tinetti test assessing postural balance, it was discovered that the mean score before the therapy was 9.03 pts, and after the hippotherapy program it was 10.83 pts. The therapy conducted statistically significantly ($p < 0.05$) improved the score in the test and the mean difference was 1.8 pts (Table 1).

Based on the gait assessment part of the Tinetti test, it was observed that the mean score before the therapy was 7.6 pts, and after the therapy it was 8.57 pts. A statistically significant difference ($p < 0.05$) was found between the scores obtained in the gait assessing part before and after the therapy. The therapy implemented significantly improved the score in the test and its mean score difference was 0.97 pts (Table 2).

Based on the Tinetti test conducted before hippotherapy, 15 out of a total of 30 participants had a high risk of falls, 14 were prone to a fall, and 1 child had a low risk of a fall. After the two weeks of hippotherapy, the comparison of general results of the Tinetti test revealed a statistically significant improvement ($p < 0.05$) since only 11 participants had a high risk of falls, 9 were prone to a fall, and 10 participants had a low risk of falls. The mean result before the therapy was 16.63 pts, and after the therapy it was 19.40 pts. Those differences were statistically signif-

Table 1. Tinetti test – balance assessment part; comparison of scores before and after therapy

Body balance	n	\bar{x}	SD	Maks	Min	$\bar{x}_1 - \bar{x}_2$	t	p
1 before therapy	30	9,03	4,00	14	0	-1,8	-7,761	0,000
2 after therapy		10,83	3,99	16	0			

Table 2. Tinetti test – gait assessment part; comparison of scores before and after therapy

Gait evaluation	n	\bar{x}	SD	Maks	Min	$\bar{x}_1 - \bar{x}_2$	t	p
1 before therapy	30	7,6	3,50	12	0	-0,97	-5,491	0,000
2 after therapy		8,57	3,46	12	1			

Table 3. General result of Tinetti test – comparison before and after therapy

Tinetti Test	n	\bar{x}	SD	Maks	Min	$\bar{x}_1 - \bar{x}_2$	t	p
1 before therapy	30	16,63	7,30	26	1	-2,77	-8,537	0,000
2 after therapy		19,40	7,13	27	1			

Table 4. Timed Up and Go Test – comparison before and after therapy

Timed Up and Go Test	n	\bar{x}	SD	Maks	Min	$\bar{x}_1 - \bar{x}_2$	t	p
1 before therapy	30	11,97	4,75	26	7	1,03	5,477	0,000
2 after therapy		10,93	4,33	25	6			

icant ($p < 0.05$). The hippotherapy program significantly improved the general result of the test and the mean difference was 2.77 pts (Table 3).

The statistical analysis of the TUG test revealed that the mean score before the therapy was 11.97 s, and after the therapy it was 10.93 s. Rehabilitation consisting of hippotherapy sessions significantly shortened the performance time of the TUG test ($p < 0.05$), and the mean difference was 1.03 s (Table 4).

Discussion

Sensory deficits typical of ICP, including vision and proprioception problems, can cause postural and balance disturbances which may considerably affect the performance of locomotor tasks. Stable posture is essential for the performance of more and more complex motor tasks, and for the coordination improvement. Hippotherapy can be used in such cases in which it brings the results which could not be accomplished by means of other physiotherapy methods, or as a rehabilitation supporting therapy.¹⁵ It covers extensive activities which aim to improve postural and balance control in children with ICP, and it may improve performance of everyday activities, self-reliance and the quality of life of those children.¹⁶ The ability to control body posture is the most important part of motor abilities.¹⁷

The results of the authors quoted coincided with our results, which confirmed the effectiveness of hippotherapy reflected in improved balance and gait in children with ICP who participated in the two-week hippotherapy program. Other researchers from different research centres reported in their studies that both long-lasting hippotherapy programs and single hippotherapy sessions significantly improved static and dynamic balance, and gait in children with diagnosed balance deficits. A six-week hippotherapy program, consisting of sessions conducted twice a week per 45 minutes, significantly improved pos-

tural balance and everyday functioning in children aged 5–16 yrs.¹⁸ An eight-week hippotherapy program significantly improved the gait speed and length, and pelvic kinematics in children with ICP.¹⁹ Equine-assisted therapy improved the quality of body posture, muscle tone and postural balance in children with severe spasticity of ICP.²⁰ The study of Maćkow et al., revealed that a single hippotherapy session may significantly move the point of the centre of gravity (COG) in the frontal plane, and it may affect the mean speed of oscillation in the sagittal plane in children with ICP.²¹ The study of Manikowska et al., also discovered beneficial effects of a single hippotherapy session on the temporal and spatial gait parameters in children with ICP. The speed of gait significantly increased after a single hippotherapy session and the remaining parameters came close to the reference values for a given age. The step length was the only parameter which got worse, but those changes were not of statistical importance.²²

The studies of many authors, as well as our studies, revealed that hippotherapy improved postural balance and gait, but we still lack research which would assess the long term effects of hippotherapy after the completion of the program. Based on such findings, it would be possible to determine the best duration time of the hippotherapy program and its sessions in order to maintain the effects for as long as possible.

As it is known, damaged brain tissue does not regenerate and the accomplishment of many motor skills is possible only through compensation. This process needs to be directed extremely skilfully because by providing adequate stimuli it is possible to create, consolidate, retain and make anticipated motor activities automatic. In the process of rehabilitating a child with ICP we strive to work out such motor skills which – despite brain damage – would maximally be similar to proper motor patterns, would prevent contractures and secondary deformities

in the osteoarticular system and would avert retaining pathological locomotor patterns. Rehabilitation, using therapeutic properties of the horse and hippotherapy, may improve balance and muscular coordination, as well as sensory integration and motor skills. Hippotherapy may beneficially affect the central nervous system and locomotor patterns trained during the therapeutic horse riding and it may improve locomotor patterns of the child in their everyday activities.¹

Study Limitations

The study is limited by the lack of comparing its results to the controls. However, the effects observed encourage us to further research.

Conclusion

1. Hippotherapy significantly improved postural balance in children with ICP.
2. Equine-assisted therapy positively affected the quality of gait and significantly decreased the risk of accidental falls in children who participated in the rehabilitation program.

Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflicts of interest.

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