

Rehabilitation of spastic tetraplegia in pediatrics: advantages of hydro-kinesitherapy

Franceska DERVISHALIAJ

CENTER OF REHABILITATION AND SPORTS MEDICINE,
UNIVERSITY OF MEDICINE “LADY OF GOOD COUNSEL”, TIRANA, ALBANIA
E-MAIL: FRANCESKADERVISHALIAJ@GMAIL.COM

Abstract

Background: *At the base of this study there is the rehabilitation of spastic tetraplegia observed in a pediatric setting. Spastic tetralgia is a severe form of cerebral palsy (PCI), including all four limbs and characterized by rigidity or permanent contraction of the affected muscles. The latter is a persistent but not immutable disorder of posture and movement due to alterations in brain function due to pre-, peri- or post-natal causes, before the growth and development of the central nervous system is completed.*

Objective: *To demonstrate how a treatment of at least 6 months can give satisfactory results, even in pathological conditions such as tetraplegia. Attention is paid to treatment methods, and therefore to the rehabilitation of this pathology from the point of view of physio-kinesitherapy.*

Methodology: *An investigation and an experimental study was conducted using interviews and treatments of referred patients 2-10 years old. The interviews were carried out with parents coming from Tirana and suburbs. Data collected showed us the specific needs of each child living with the family and it was created a tailored rehabilitation plan for each of them. **Results:** *Despite suffering from a severe condition, there have been significant improvements in the generic framework, especially on the activities of daily life, thus alleviating the difficulties these children are facing. The handling of each child with empathy and personalized care is needed**

to obtain satisfactory results. **Conclusion:** Results showed how all the children taken in charge had an improvement in their quality of life. Their communication and even collaborative skills have improved.

Key words: Physiotherapy, Physical Therapy, Cerebral palsy, tetraplegic, rehabilitation, children, Aqua therapy, disability

Introduction

Cerebral palsy (CP) is the most common physical disability in childhood that affects the development of movement. Children with cerebral palsy usually survive into adulthood and the condition is often understood lately in adulthood. In fact, impairment can vary considerably and different people with cerebral palsy aren't affected in exactly the same way. Recognizing and managing the comorbidities of cerebral palsy is as important as treating motor disabilities. Unfortunately it cannot be cured only with a series of targeted interventions or functional capacities [1]. Cerebral palsy is "a generic term" that covers a group of non-progressive, but often changeable, motor impairment syndromes, secondary to brain injuries or abnormalities that arise in the early stages of development [2]. Approximately 2 to 2.5 out of every 1000 live births in the Western world are affected [3], with higher incidences among premature infants and twins [4,5]. Cerebral palsy is characterized by atypical control of movements and positions, arising from early brain damage or dysfunction (prenatal, perinatal or postnatal). Motor disorders in cerebral palsy encompass neuromuscular and musculoskeletal abnormalities, including abnormal muscle tone, spasticity, dyskinesia, dystonia, athetosis, bone deformities, balance issues, and loss of selective motor control [6]. But our attention shifts to a type of Palsy, namely Spastic Tetraplegia. This is the partial paralysis of all four limbs due to extensive brain damage caused by lesions suffered in the prenatal, perinatal, or neonatal period, or by congenital malformations of the brain localized in the pyramidal system (part of the brain from which the impulses necessary for motor function originate). It is the most severe form of cerebral palsy [7]. It is characterized by permanent stiffness or contraction of the affected musculature. However, the severity of the condition can vary from child to child [1]. In fact, we can have moderate spastic tetraplegia, where individuals may, for example, be able to sit alone and walk short distances. On the other hand, those suffering from more severe forms of quadriplegia tend to have great difficulty carrying out every activity of daily living [7]. It can be due to several causes, such as infections, oxygen deprivation, umbilical cord prolapses, and trauma caused by the use of forceps and suction cups. However, perinatal asphyxia is thought to be a major cause of cerebral



palsy [8]. As for infections, they are increasingly implicated [9]. In the forms of spastic tetra paresis, the motor disorder affects the lower and upper limbs equally and generally manifests itself from birth, although it may become visible around twelve to eighteen months [10]. Symptoms of quadriplegia include difficulty or inability to communicate (dysarthria or anarthria), visual disturbances (visual agnosia, gaze paralysis, strabismus, reduced visual acuity, etc.), hearing function disorders, epilepsy (infantile spasms, Lennox-Gastaut syndrome, etc.), cognitive disorders, diffuse muscle contractures, and deformities in the joints and spine trim [10].

Physical Therapy or Aquatherapy

Physical therapy (PT) plays a central role in managing the condition by focusing on function, movement, and optimizing the child's potential. The physiotherapist uses physical approaches to promote, maintain, and restore physical, psychological, and social well-being [11]. Numerous therapeutic interventions are employed to minimize the development of secondary problems (such as normalization of tone and an increase in active range of motion), to enhance muscle strength and mobility, to attain functional motor skills for postural adaptation in various antigravity situations, and to promote functional independence at home, school, and in the community, which is necessary for daily autonomy [12]. In addition to physical therapy, hydro kinesitherapy is one of the most popular supplementary treatments for children with neuromotor disabilities [13]. This refers to the branch of rehabilitation medicine that utilizes water as a therapeutic tool, capitalizing on its hydrostatic, hydrodynamic, thermal, and metabolic properties. It is particularly beneficial for children with tetraplegia, offering an alternative exercise with low impact that is safe and advantageous [14].

In fact, water serves as an equalizing medium; its nature, which minimizes gravity, reduces joint compressive forces, providing a more conducive exercise environment for medical conditions that may limit physical training on land [15]. Adapted aquatic exercises have been particularly recommended as part of physical activity programs for children with CP. The buoyant nature of water affords individuals with CP the opportunity to experience a sense of freedom from the constraints they face on solid ground [16]. Water-based activities aid in relieving pain and muscle spasms, maintaining or increasing range of motion, strengthening weak muscles, re-educating paralyzed muscles, improving circulation, lung function, and speech, as well as contributing to the maintenance and improvement of balance, coordination, and posture [17]. The reduction in weight-bearing and ease of movement allows for safe exploration of movement, strengthening, and functional activity training with reduced joint load and impact, providing a

gentler environment for children suffering from persistent abnormal load [18,17]. Moreover, aquatic physical activities play a crucial role in the teaching-learning process and could promote greater independence, enhanced manual ability, and consequently, increased social participation for individuals with CP [19].

Methodology

Aim of the Study

In addressing objectives within the domain of quadriplegia, it is essential to delineate and discern those vested in the physiotherapist, the child's family, and fundamentally, those intrinsic to the child. The physiotherapist's objectives encompass the improvement of respiratory function, facilitation of environmental interaction, precise and diversified positioning, adaptation to postural antigravity modalities as alternatives to supine orientations, identification of specific assistive devices and orthoses, implementation of verbal/nonverbal communication modalities, preservation of musculoskeletal integrity, identification of functional strategies conducive to daily self-reliance, and autonomy within the social milieu (inclusive of modes of communication and participation in scholastic activities).

For the family, this study attempts to foster an awareness of their child's latent potential, discern prevailing challenges and issues, impart guidance for an adept and refined manual proficiency in the daily care of the child (inclusive of hygienic practices and dressing), proffer counsel on the careful utilization of aids for the accurate positioning of the child, offer recommendations for an appropriate administration of nutrition and the facilitation of rudimentary functions (chewing and swallowing), and ascertain behaviors encouraging dual communication (encompassing the utilization of gaze, mimicry, voice, and touch).

With regard to the child, this study attempts to effectuate enhancements in autonomic regulation, mastery over oral functions, and the cultivation of an accepting disposition towards sustenance. It also seeks to stimulate a heightened sense of initiative and interaction with the surroundings, facilitate seamless adaptation to antigravity postural configurations, and inculcate efficacious communication strategies.

However, it is noteworthy that the objectives of this study underwent dynamic evolution concurrent with the progress of the therapeutic interventions. Indeed, additional objectives were incorporated mid-treatment, including familiarization with aquatic environments, the establishment of a trusting relationship between



therapist and patient, acquisition of proficiency in facilitative movements for aquatic entry, mastery of initial movements and attaining confidence in one's body and its idiosyncrasies, cultivation of a positive self-image, and the realization that the sessions need not evoke anxiety or trepidation, but rather, should be perceived as moments of leisure and play.

Sample

This study included 10 patients referred in 2017, 6 males and 4 females from the age of 2 to 10 years old, all living in Tirana and its districts.

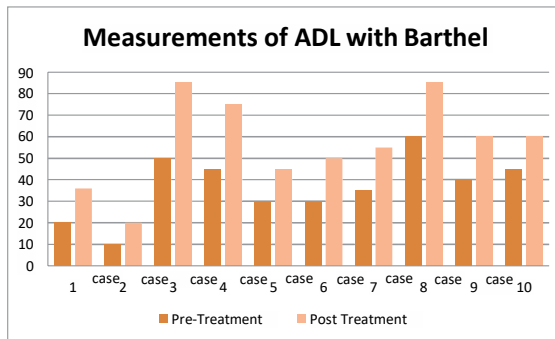
Data Instrument

A fundamental method for measuring and evaluating the daily activities of a child and assessing their integration within the family, as well as their ability to perform specific actions, is the Evaluation Scale for Daily Life Activities, commonly known as the "Barthel Index". In this study, the Barthel Index was utilized, providing an indicative score of the subject's ability to eat, dress, manage personal hygiene, wash, use the toilet, move from chair to bed and vice versa, walk on flat ground, ascend and descend stairs, and control defecation and urination. Each of these skills or functions is assigned with a score of either 15, 10, 5, or 0. For instance, 10 points are awarded if the subject feeds themselves, and 5 points if they require assistance (for example, in cutting food). In terms of controlling urination and defecation, a patient who independently manages these needs is considered independent; requiring assistance if they need any form of help, even partial, in using tools; and dependent if they use a catheter or experience episodes of incontinence, even occasionally. The maximum score of 100 is only awarded if the patient performs the task entirely independently, without the presence of any care personnel [20]. Another assessment tool employed was the ICF classification: International Classification of Functioning, Disability, and Health. This classification includes qualifiers ranging from 0=NONE to 4=COMPLETE, indicating the extent of the impairment. Its aim is to describe individuals' health status in relation to their social, family, and work environments, and consequently, their degree of impairment [21]. The data were collected through questionnaires administered to the parents of the children at the "Lady of Good Counsel" Rehabilitation Center, where they received treatment for a minimum duration of 6 months. In relation to the interviews conducted with parents regarding their children's performance of daily activities, both before and after treatment, the evaluation of the treated cases was carried out.

Results

The two chosen methods are the evaluation of Activities of Daily Living (ADL) using the Barthel Index, and the ICF scale for impairments. Based on the data obtained from these two methods, graphs were generated to facilitate a clearer observation of the results before and after treatment (pre/post treatment).

FIG. 1: Measurements of Activities of Daily Living using the Barthel Index

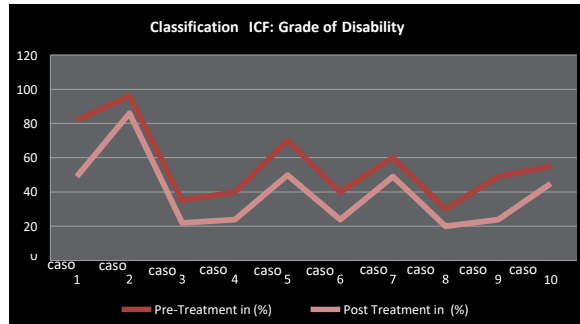


TAB 1: Scores of patients pre and post treatment

Case no.	Pre-treatment score	Post-treatment score
1.	20 /100	35 /100
2.	10/100	20/100
3.	50/100	85/100
4.	45/100	75/100
5.	30/100	45/100
6.	30/100	50/100
7.	35/100	55/100
8.	60/100	85/100
9.	40/100	60/100
10.	45/100	60/100

The difference between pre-treatment and post-treatment in Activities of Daily Living (ADL) is evident in all patients, including those in more severe conditions, where a notable improvement is observed. One can discern the positive change and the dedication that has been put into achieving these results within just six months of treatment.

FIG. 2: Grade of Disability Pre- and Post-Treatment



Also, in the ICF classification there is a clear reduction in the degree of impairment in patients.

Discussion

Based on the obtained results, progress is evident for all the examined patients. Each patient exhibited improvement corresponding to their degree of disability. The initial graph which evaluates the activities of daily living vividly illustrates the contrast between pre-treatment and post-treatment phases. The pre-treatment data were gathered through interviews with parents, providing essential insights into the child's capabilities and areas for targeted intervention. Conversely, the post-treatment phase shows the significant improvements achieved by patients. Remarkable improvements were observed after approximately six months of treatment, attributable not only to the therapeutic interventions but also to the determination displayed by children themselves during physio-kinesitherapy and hydro kinesitherapy sessions. It is crucial to emphasize that every improvement, no matter how incremental, constitutes a substantial milestone for both the physiotherapist and the patient's family. Witnessing them accomplishing tasks previously beyond their reach is a momentous achievement for all parties involved.

The second graph delineates the degree of impairment according to the ICF classification. This measurement is expressed as a percentage, utilizing a generic qualifier on a negative scale to indicate the extent or severity of the impairment. [22]: NO impairment (absent, negligible) 0-4%, MILD impairment (light, small) 5-24%, MODERATE impairment (moderate, fair) 25-49%, SEVERE impairment (remarkable, extreme) 50-95%, COMPLETE impairment (total) 96-100%. [22].

Through the ICF evaluation, we derived percentages both pre-treatment and post-treatment. Initially, we established a baseline assessment through careful

observation of the child's capabilities. This formed the basis for assigning a percentage indicative of the level of impairment. Following six months of physio-kinesitherapy, we conducted a subsequent evaluation, revealing a notable reduction in the degree of impairment compared to the outset – that is a significant accomplishment.

Conclusion

This study stressed the profound significance of working with children, particularly those coping with spastic tetraplegia. It is an effort both crucial and delicate, demanding steady commitment and boundless patience. Understanding the clinical profile of each child is the initial step, enabling tailored therapeutic approaches. In this realm, teamwork is paramount; objectives extend not only to the physiotherapist but also encompass the child and their family. The role of the family, while potentially constructive, can also pose challenges. Some families struggle to accept their child's condition, harboring hopes pinned solely on the promise of a miraculous recovery through physiotherapy. This underscores the complexity of working with families in denial and emphasizes the importance of recalibrating expectations. Short-term goals have been met within these six months. Long-term objectives remain a work in progress, acknowledging the unique circumstances of these children. In essence, the study's goal of improvement, no matter how incremental, has been realized. Each modest stride forward is a testament to the efficacy of targeted treatments and meticulous evaluation. A pivotal element in the regimen is water-based therapy or hydro kinesitherapy. It motivates children to exert themselves further, providing a temporary reprieve from their disability. The key, as always, is playfulness. Viewing tasks as games fosters a more engaged approach, easing the therapeutic process. Approaching each child demanded a tailored strategy, acknowledging their distinct diagnoses and individual personalities. Treating children necessitates a different paradigm, marked by incremental progress towards tangible goals. Recognizing their achievements, no matter how small, fosters a sense of capability and trust. The ultimate aim is to nurture a sense of autonomy within each child's realm of possibility, enabling them to perform certain tasks independently. This extends to their reintegration into society, fostering a sense of belonging and acceptance. Encouraging confidence in themselves is paramount, challenging a proactive engagement with daily life and demolishing their passive role. Working with children has been a departure from routine, demanding a unique approach characterized by nuanced steps towards well-defined objectives. Acknowledging and valuing their contributions, no matter how modest, lays the foundation for progress. This journey is guided by empathy,



attentiveness to their cues, and a holistic view of their needs, encompassing both therapy and emotional support. In summary, this experience has not only produced evident improvements but also enriched our understanding of the resilience and potential inherent in each child, despite the challenges they face. It reaffirms the profound impact of personalized, empathetic care in enhancing the lives of these young individuals.

References

1. Rosenbaum, P. (2003). Cerebral palsy: What parents and doctors want to know? *BMJ*, 326(7396), 970–974. doi: 10.1136/bmj.326.7396.970
2. Mutch, L. W., Alberman, E., Hagberg, B., Kodama, K., & Velickovic, M. V. (1992). Cerebral palsy epidemiology: Where are we now and where are we going? *Dev Med Child Neurol*, 34, 547–555.
3. Stanley, F. J., Blair, E., & Alberman, E. (2000). *Cerebral palsies: Epidemiology and causal pathways*. London: Mac Keith.
4. Escobar, G. J., Littenberg, B., & Petitti, D. B. (1991). Outcome among surviving very low birthweight infants: A meta-analysis. *Arch Dis Child*, 66, 204–211.
5. Nelson, K. B., & Ellenberg, J. H. (1995). Childhood neurological disorders in twins. *Paediatr Perinat Epidemiol*, 9, 135–145.
6. Flett, P. J. (2003). Rehabilitation of spasticity and related problems in childhood cerebral palsy. *J Paediatr Child Health*, 39(1), 6–14.
7. Allotey, P., et al. (2003). Context and the determinants of the severity of disease: An exploratory comparison of tetraplegics in Australia and Cameroon. *The DALY, Social Science & Medicine*, 57, 949–958. doi: [http://dx.doi.org/10.1016/S0277-9536\(02\)00463-X](http://dx.doi.org/10.1016/S0277-9536(02)00463-X)
8. Nelson, K. B. (1988). What proportion of cerebral palsy is related to birth asphyxia? *J Pediatr*, 112, 572–574.
9. Nelson, K. B., & Willoughby, R. E. (2000). Infection, inflammation, and the risk of cerebral palsy. *Curr Opin Neurol*, 13, 133–139.
10. Cans, C. (2000). Surveillance of cerebral palsy in Europe: A collaboration of cerebral palsy surveys and registers. *Dev Med Child Neurol*, 42, 816–824.
11. Anttila, H., Autti-Rämö, I., Suoranta, J., Mäkelä, M., & Malmivaara, A. (2008). Effectiveness of physical therapy interventions for children with cerebral palsy: A systematic review. *BMC Pediatr*, 8, 14. doi: 10.1186/1471-2431-8-14.
12. Declerck, M. (2010). *Effect of aquatic intervention on the gross motor function and quality of life of children with cerebral palsy*. Leuven: Catholic University of Leuven, Faculty of Kinesiology and Rehabilitation Sciences.
13. Getz, M. D. (2006). *Aquatic Intervention in Children with Neuro-Motor Impairments [dissertation]*. Utrecht: University of Utrecht.
14. Fragala-Pinkham, M., Haley, SM., & O'Neil, ME. (2008). Group aquatic aerobic exercise for children with disabilities. *Dev Med Child Neurol*, 50(11), 822–827.
15. Takeshima, N., Rogers, ME., Watanabe, E., Brechue, WF., Okada, A., Yamada, T., et al. (2002). Water-based exercise improves health-related aspects of fitness in older women. *Med Sci Sports Exerc*, 34(3), 544–551.

16. Getz, M., Hutzler, Y., & Vermeer, A. (2007). The Effects of Aquatic Intervention on Perceived Physical Competence and Social Acceptance in Children with Cerebral Palsy. *Eur J Spec Need Educ*, 22(2), 217–228.
17. Cole, A., & Becker, B. (Eds.). (2004). *Comprehensive aquatic therapy*. (2nd ed.). Philadelphia: Elsevier.
18. Kelly, M., & Darrah, J. (2005). Aquatic exercise for children with cerebral palsy. *Dev Med Child Neurol*, 47(12), 838–842.
19. Aidar, F. J., Silva, A.J., Reis, V.M., Carneiro, A.L., Vianna, J.M., & Novaes, G.S. (2007). Aquatic activities for severe cerebral palsy people and relation with the teach-learning process. *Fit Perf J*, 6(6), 377–381.
20. Prodinge, B., O'Connor, R.J., Stucki, G., & Tennant, A. (2017). Establishing score equivalence of the Functional Independence Measure motor scale and the Barthel Index, utilising the International Classification of Functioning, Disability and Health and Rasch measurement theory. *J Rehabil Med*, 49(5), 416-422. doi: 10.2340/16501977-2225
21. A. Rauch, A. Cieza, & G. Stucki. (2008). How to apply the International Classification of Functioning, Disability and Health (ICF) for rehabilitation management in clinical practice. *Eur J Phys Rehabil Med*, 44(3), 329-342.
22. Ewert, T., Grill, E., Bartholomeyczik, S., Finger, M., Mokrusch, T., Kostanjsek, N., & Stucki, G. (2005). ICF Core Set for patients with neurological conditions in the acute hospital. *Disabil Rehabil*, 27(7-8), 367-373. doi: 10.1080/0963828040001

