SciMedCentral
Annals of Pediatrics & Child Health

Case Report

Influence of Electrothermotherapy on Spasticity in Cerebral Palsy: Case Report

João Marcos Brandet*and Heloísa Lopes Borges

Department of Physiotherapy, Centro Universitário Filadélfia (UniFil), Brazil

*Corresponding author

João Marcos Brandet, Rua Cristiano Machado, 20 Apto 502, Londrina, Paraná, Brazil, Tel: 55 43 98411-7430; Email: jmbrandet@edu.unifil.br

Submitted: 10 June 2021

Accepted: 27 July 2021

Published: 30 July 2021

ISSN: 2373-9312

Keywords
- Cerebral palsy
- Cryotherapy
- Ultrasonic therapy
- Developmental disorders

Abstract

Objective: To analyze the influence of cryotherapy and thermotherapy on spasticity in cerebral palsy. Methods: The sample consisted of a patient with spastic cerebral palsy sequels, female, and 10 years old of Centro Universitario Filadelfia (UniFil). Patient was assessed by: Pediatric Neurofunctional Assessment and Pediatric Evaluation Disability Inventory. It was evaluated the passive amplitude of motion (goniometry) and the level of spasticity by the Modified Ashworth Scale, before and after the physiotherapeutic intervention in muscles with spasticity. The physiotherapeutic treatment (cryotherapy/20min; continuous therapeutic ultrasound/1MHz, 0.5w/cm²), was managed in 10 sessions during 5 weeks, lasting 30 minutes each session. The Spearman correlation was used for the analysis of the non- parametric variables and the Pearson correlation for the parametric variables. Results: The results found indicates increased muscle flexibility and reduced the degree of spasticity (being the value of $p < 0.0001$ for both studied variables). Discussion: This study was effective in decreasing muscle spasticity with consequent improvement in the amplitude of joint movement. The application of cryotherapy and therapeutic ultrasound makes these resources important for therapeutic practice. Further research is needed to increase the sample size so that the results for this type of patient can be generalized.

INTRODUCTION

Spasticity is a motor disorder characterized by velocity-dependent increase in muscle tone associated with exacerbation of the myotatic reflex [1]. Spasticity in combination with paresis is one of the most common neurological syndromes and develops as a result of damage to the supraspinatus or spinal descending motor system with mandatory involvement of the corticospinal tract [2]. Spasticity is a disturbed sensorimotor control due to damage to the first motor neuron, which is associated with intermittent or permanent involuntary muscle activation [2]. The development of spasticity significantly reduces functional activity and increases patients' disability, worsening quality of life. Theoretically, the exaggeration of the stretch reflex in patients with spasticity could be produced by two factors. The first is an increase in the excitability of muscle spindles. In this case, the passive stretching of the muscle in a patient with spasticity would induce a greater activation of the spindle afferences in relation to that induced in a normal subject, of course considering a similar velocity and amplitude of passive dislocations. The second factor is an abnormal processing of the sensory inputs of the spinal cord muscle spindles, leading to an excessive reflex activation of alpha motoneurons [3-6]. The dependence of spasticity on speed can be attributed to the sensitivity to afferent Ia velocity. However, several studies suggest that afferent fibers II of muscle spindles are also involved in spasticity, activating alpha motoneurons through an oligosynaptic path [7,8]. It has been suggested that afferent fibers II, which are dependent on length, could be responsible for muscle contraction in isometric conditions frequently seen after the dynamic phase of the stretch reflex in patients with spasticity [9]. The continuous application of cryotherapy promotes the reduction of spasticity by decreasing the neurotransmission of afferent and efferent impulses, as the ice, physiologically, causes a decrease in the osteotendinous and skin reflexes, initially increasing the fusal discharge and soon afterwards promoting the reduction in this discharge, decreasing the electrical activity of the muscle. Therefore, this cooling, in addition to reducing the speed of nerve conduction, results in a decrease in muscle spasm [10]. From a biophysical point of view, therapeutic ultrasound is a type of irradiation that promotes the heating of tissues due to the absorption of part of its irradiated energy, causing an increase in local blood flow, resulting in a temporary increase in the extensibility of collagenous structures, such as tendons, ligaments and joint capsule, decreased joint stiffness, reduced pain and muscle spasm [11]. Cryotherapy and thermotherapy provide an effective, practical means to reduce spasticity of muscles resulting from a central nervous system dysfunction. This study aims to analyze the effects of cryotherapy and thermotherapy on spasticity.

CASE PRESENTATION

It is a case report, with a quantitative approach that was carried out in the Physiotherapy Clinic of Centro Universitario Filadelfia (UniFil). The patient in this research is a 10-year-old woman with spastic quadriplegia due to cerebral palsy. The sample included a patient with a clinical diagnosis of spastic cerebral palsy, being under the age of 14 years old, not having osteomioarticular deformities installed in the lower limbs, not having an allergy to ice or heat, not having another physical therapy treatment or using botulinum toxin. In the Pediatric Neurofunctional Assessment, the patient presented limited amplitude of motion of the upper and lower limbs, did not walk and stood with only support, a good level of awareness, but spoke with difficulty. On physical examination, it was observed that the patient had hypotrophism in the muscles of the upper and lower limbs. The patient had bilateral flexor pattern hypertonia in the upper limbs and bilateral extensor pattern hypertonia in the lower limbs. Shortening of the hamstrings and plantiflexors was observed in the lower limbs. The patient had the following primitive reflexes: asymmetrical tonic neck reflex and symmetrical tonic neck reflex. The patient did not have deep tendon reflexes (bicep, brachioradialis, triceps, patellar and ankle). The patient had impaired motor coordination and was taking medication (risperidone). The Pediatric Evaluation of Disability Inventory (PEDI) was applied to the patient to evaluate functional skills in the domains of self-care, mobility, and social function. The patient presented disabilities for basic and instrumental activities of daily living. The patient is totally dependent on personal hygiene, self-care and mobility activities. The most hypertonic muscle was quadriceps femoris muscle in the right lower limb with grade 4 by Modified Ashworth Scale. The patient was positioned as follows: Side lying, with the hips and knees in maximum extension. Head and trunk are in a straight line. A pillow was used behind the hips to stabilize the patient. Behind the patient, examiner placed one hand just proximal to the knee, on the lateral surface of the thigh, to stabilize the femur and one hand just proximal to the ankle. The knee was moved from maximum extension to maximum flexion. The passive amplitude of motion (goniometry), was evaluated for knee flexion in the right lower limb. For goniometry, patient was in prone with test-side ankle off plinth and leg in extension. Axis location of goniometer was lateral epicondyle of the femur, stationary arm was along the femur to the greater trochanter and movement arm was along the fibula to lateral malleolus.

It was evaluated the passive amplitude of motion (goniometry), and the level of spasticity by the Modified Ashworth Scale, before and after the physiotherapeutic intervention in muscles with spasticity. The physiotherapeutic treatment was managed in 10 sessions during 5 weeks, lasting 30 minutes each session. The ice pack (cryotherapy), was applied to the muscle belly to be treated, with duration of 20 minutes at 15°C, and in the same session, continuous therapeutic ultrasound (Sonopulse, IBRAMED – Brazil) was applied with a frequency of 1MHz and intensity of 0.5w/cm^2 in the tendon of the analyzed muscle. The temperature of the thermal agents before, during and after the physiotherapeutic intervention was constantly monitored by the infrared thermometer.

The Spearman correlation was used for the analysis of the non- parametric variables and the Pearson correlation for the parametric variables. The data were analyzed using the Statistical Package for Social Science software (SPSS, 27.0). The Student t test (paired) was applied to compare the passive amplitude of motion (goniometry) measurements and for the level of spasticity (Ashworth scale) was applied the Wilcoxon Ranks Test, used for categorical variables.

The results found indicates increased muscle flexibility and reduced the degree of spasticity (being the value of $p < 0.0001$ for both studied variables). The mean measures of flexion of the right knee increased from 105.1 pre-intervention to 132.3 post-intervention ($p = 0.0001$; Table 1). The level of spasticity went from XX before treatment to XX after physical therapy ($p < 0.0001$; Table 2).

DISCUSSION

The application of cryotherapy to the quadriceps femoris muscle was effective in reducing the patient's spasticity and improving the static postural pattern assumed by the lower limb with a consequent increase in muscle flexibility. The decrease in temperature caused by cryotherapy leads to a reduction in muscle action, facilitating the reduction of spasticity. Cryotherapy

Table 1: Goniometry of knee flexion before and after physical therapy intervention.

Sessions	Pre-intervention	Post-intervention	P-value
1	95	128	
2	98	128	
3	100	128	
4	102	130	
5	106	130	
6	108	132	
7	110	134	
8	108	135	
9	112	140	
10	112	138	
Mean	105.1	132.3	0.0001
Standard deviation	6.00	4.32	

Table 2: Degree of Spasticity of the quadriceps femoris muscle before and after physical therapy intervention.

Before	After	Difference
4	2	2
4	2	2
3	2	1
3	2	1
3	2	1
3	2	1
3	2	1
3	2	1
2	1	1
2	2	0
(p< 0.0001)		

reduces spasticity for up to 60 minutes after application, reduces muscle action and promotes relaxation for about 30 minutes to 2 hours after application. The literature suggests that the application of cold should be carried out for at least 20 minutes, emphasizing that applications for shorter times could not be effective to reach deep tissues [12-14]. A study treated 23 patients with a variety of musculoskeletal and neurological disorders for 20 minutes with towels soaked in cold water. After one or more treatments, the pain was sufficiently reduced or eliminated in 74% of the patients with pain. Range of motion improved in 94% of patients with limited range of motion and spasticity decreased in 67% of patients with spasticity [15]. A study has shown that local cooling of muscles temporarily reduces spasticity and muscle contractions, mainly by reducing the sensitivity of spindle muscles to stretching [16]. In a study of patients with motor neuron damage in the upper body, spasticity and muscle contractions were reduced with towels wet with crushed ice and immersion in cold water [17].

The increase in the amplitude of motion for knee flexion can be explained by the decrease in spasticity and the increase in the extensibility of the tendon of the quadriceps femoris muscle. The extensibility of the tendon can be increased by raising the temperature, with the result that stretching at certain intensity will produce greater stretching if heat is applied. There is scientific evidence that the increased tone associated with injuries to upper motoneurons can also be reduced by warming up [18]. Ultrasound stimulates the thick afferent fiber with post-excitatory inhibition of orthosympathetic activity, reducing tone and relaxing the muscles. In addition, the conduction velocity of the peripheral nerves decreases, and temporary blockages can occur, increasing the temperature to 3ºC above the normal baseline, the muscle spasm is eliminated, the function of using the muscles is inhibited and they open the lymphatic channels [19,20].

This study was effective in decreasing muscle spasticity with consequent improvement in the amplitude of joint movement. The application of cryotherapy and therapeutic ultrasound makes these resources important for therapeutic practice aiming at improving the clinical condition of the patient. Further research is needed to increase the sample size so that the results for this type of patient can be generalized.

REFERENCES

1. Mukherjee A, Chakravarty A. Spasticity mechanisms - for the clinician. Front Neurol. 2010; 1: 149.
2. Malhotra S, Pandyan AD, Day CR, Jones PW, Hermens H. Spasticity, an impairment that is poorly defined and poorly measured. Clinical rehabilitation. 2009; 23: 651-658.
3. Kamper DG, Schmit BD, Rymer WZ. Effect of muscle biomechanics on the quantification of spasticity. Ann Biomed engineering. 2001; 29: 1122-1134.
4. Thilmann AF, Fellows SJ, Garms E. The mechanism of spastic muscle hypertonus: variation in reflex gain over the time course of spasticity. Brain. 1991; 114: 233-244.
5. Järvinen TA, Józsa L, Kannus P, Järvinen TL, Järvinen M. Organization and distribution of intramuscular connective tissue in normal and immobilized skeletal muscles. J Muscle Res Cell Motility. 2002; 23: 245-254.
6. McLachlan EM, Chua M. Rapid adjustment of sarcomere length in tenotomized muscles depends on an intact innervation. Neuroscience Letters. 1983; 35: 127-133.
7. Marque P, Simonetta-Moreau M, Maupas E, Roques CF. Facilitation of transmission in heteronymous group II pathways in spastic hemiplegic patients. J Neurol, Neurosurg Psychiatry. 2001; 70: 36-42.
8. Nardone A, Schieppati M. Reflex contribution of spindle group Ia and II afferent input to leg muscle spasticity as revealed by tendon vibration in hemiparesis. Clinical Neurophysiol. 2005; 116: 1370-1381.
9. Sheean G, McGuire JR. Spastic hypertonia and movement disorders: pathophysiology, clinical presentation, and quantification. PM&R. 2009; 1: 827-833.
10. Correia ADCS, Silva JDS, Silva LVCD, Oliveira DAD, Cabral ED. Crioterapia e cinesioterapia no membro superior espástico no acidente vascular cerebral. Fisioterapia em Movimento. 2010; 23: 555-563.
11. Baker KG, Robertson VJ, Duck FA. A review of therapeutic ultrasound: biophysical effects. Physical therapy. 2001; 81: 1351-1358.
12. Miglietta O. Action of cold on spasticity. Am J Physical Medicine & Rehabilitation. 1973; 52: 198-205.
13. Felice TD, Santana LR. Recursos Fisioterapêuticos (Crioterapia e Termoterapia) na espasticidade. Revista Neurociências. 2009; 17: 57-62.
14. Guirro R, Abib C, Máximo C. Os efeitos fisiológicos da crioterapia: uma revisão. Fisioterapia e Pesquisa. 1999; 6: 164-170.
15. Chambers, R. Clinical uses of cryotherapy. Physical therapy. 1969; 49: 245-249.
16. Smania N, Picelli A, Munari D, Geroin C, Ianes P, Waldner A, Gandolfi M. Rehabilitation procedures in the management of spasticity. Eur J Phys Rehabil Med. 2010; 46: 423-438.
17. Boyraz I, Uysal H, Koc B, Sarman H. Clonus: definition, mechanism, treatment. Med Glas (Zenica). 2015; 12: 19-26.
18. Kitchen S. Eletroterapia: prática baseada em evidências, 11ª ed. São Paulo: Manole; 2003.
19. Matheus JPC, Oliveira FB, Gomide LB, Milani JGPO, Volpon JB, Shimano AC. Efeitos do ultra-som terapêutico nas propriedades mecânicas do músculo esquelético após contusão. Brazilian J Physical Therapy. 2008; 12: 241-247.
20. Radinmehr H, Ansari NN, Naghdi S, Tabatabaei A, Moghimi E. Comparison of Therapeutic ultrasound and radial shock wave therapy in the treatment of plantar flexor spasticity after stroke: a prospective, single-blind, randomized clinical trial. J Stroke Cerebrovascular Dis. 2019; 28: 1546-1554.

Cite this article

Brandet JM, Borges HL. Influence of Electrothermotherapy on Spasticity in Cerebral Palsy: Case Report. Ann Pediatr Child Health 2021; 9(6): 1245.