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CASE STUDY

Effects of Pulsed Magnetic Field combined with Electrical Muscle Stimulation on Muscle Tone and Motor Function in Hypotonic Cerebral Palsy – A Case Study

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Author`s Contribution

[1] Substantial contributions to the conception or design of the work for the acquisition, analysis or interpretation of data for the work, **[1,2]** Drafting the work or reviewing it critically for important intellectual content, **[1,2]** Final approval of the version to be published, [1,2] Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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A B S T R A C T

Cerebral palsy is characterized by abnormal tone, posture and movement with multisystem involvement leading to limitation of activity. In the given case, a female patient was reported with hypotonic Cerebral palsy with complaints of floppiness and muscular weakness predominantly affecting right side of body. She was also having poor head and neck control along with instability of trunk. The patient received Pulsed Electromagnetic Field (PEMF) therapy (25–35 Hz, 412 µs, 10 min) followed by Electrical muscle stimulation (EMS) (20–35 Hz, synchronous mode, 10 min), both applied five times weekly. This was followed by physical therapy exercises targeting the affected extremity. Data collection was done at the baseline, 12 and 24 weeks of intervention. Marked improvements in motor function were observed over 24 weeks, as evidenced by higher scores on the GMFM and advancement to GMFCS Level III, indicating enhanced mobility and postural control. Thus, it can be concluded that combination of PEMF with EMS is an effective intervention for improving Muscle Tone and enhancing Motor Function in Hypotonic Cerebral Palsy

Keywords: Cerebral Palsy, Magnetic Field Therapy, Muscle Hypotonic, Postural Balance.

Introduction

Cerebral palsy (CP) is a permanent neuro-developmental disease characterized by impaired muscle tone, posture and locomotion, occurring with rates of 1.5-3 per 1,000 live births, and with a male bias.[1] Hypotonic CP is the rare form of CP, which constitutes 2.6 percent of the cases [2] with low muscle toned leading to late motor skills milestones and low postural stability.[3] The affected children portray poor trunk control, sitting balance, and head control as a result of sensory-motor integration problems.[4] Being less frequent, hypotonic CP is specific in its treatment and is likely to have multisystem complications that can complicate daily life even further.[5] Although a number of interventions have been studied with regard to spastic CP, there is limited literature on effective modalities to be used with hypotonic CP. It has been indicated that Pulsed Electromagnetic Field (PEMF) modality and Electrical Muscle Stimulation (EMS) could independently improve motor performance and muscle recruitment in neurologically impaired subjects.[6] Nevertheless, very little research has observed the combination of the PEMF and EMS in the treatment of hypotonia in particular. Since hypotonic CP is

characterized by whitened neural input at the muscles, it is proposed that a combination of PEMF and EMS may provide synergistic efficacy, namely, neuromuscular stimulation resulting in better postural control and tone, compared with the separate application of either of the two. It was hypothesized that when PEMF with EMS is incorporated with conventional physiotherapy, it shall have a significant effect in enhancing poor motor functions and muscle tone in children with hypotonic CP. This case study was aimed at measuring the efficacy of PEMF that was used in conjunction with EMS in enhancing muscle tone, motor capacity and improving motor behavior in a child with hypotonic CP, with a 24 weeks course of treatment.

Case Report

A 4 years old female, presented at the Physiotherapy OPD of Syeda Khatoon e Jannat Trust Hospital & Special Education Centre, Faisalabad; with complaints of floppiness and muscular weakness predominantly affecting right side of body. She was also having poor head and neck control along with instability of trunk. The patient was having speech difficulties along with lack of hand grip. She was born via normal delivery after premature labor caused by pre-mature rupture of membranes at 7 months' gestation. There was no documented infections or complications during pregnancy until 7th month with no reported history of neurodevelopmental disorders or congenital abnormalities among the family. Birth complications primarily hypoxia, resulted in delayed developmental milestones and significant motor impairments

Baseline physical examination revealed that she had muscular strength of 2/5 in right Upper and lower extremity on Manual muscle testing and slouched forward leaning posture. According to GMFCS, she resided on Level V. Her neurological examination revealed reduced reflexes. She had poor grip strength and limited dexterity. Her psychiatric evaluation indicates fear pattern towards movement and extreme crying behavior. An informed consent was obtained from the caregiver before they could be included in the study. The intervention program included the application of PEMF unit followed by EMS to improve muscle tone, and enhance motor function.

PEMF (Magneto-pulse International PMF Unit-Australia) unit was applied in a frequency Between 25 Hz and 35 Hz for a duration of 10 minutes of net Field time with a pulse duration of 412 µs five times a week.[7]

EMS unit (Comfy-Stim TENS/EMS Combo Unit) was applied afterwards for a duration of 10 minutes in Synchronous mode (20 to 35 Hz) in addition to physical therapy exercises targeting the affected extremity. Exercises were implemented in the following pattern: PROM along with tactile stimulation, Assisted Head Lifts, Prone Positioning, Supported Sitting with Assistance, Supported Standing, Pre-Gait Training and Assisted Ambulation.

Every exercise was performed in 10 repetitions and was practiced approximately 10-15 minutes per day and up to 12 weeks. The second reading was administered after 12 weeks and her motor functions improved tremendously. The third and final reading was done at the end of 24 weeks.

Figure 1: Magneto-pulse International PMF Unit- Australia

Results

During the 24-week intervention term, the patient demonstrated significant improvement in the motor function and gross motor capacity.

The Gross Motor Function Measure (GMFM) score for the child at baseline (Week 0) was 19% with a level of self-mobility of GMFCS Level V, which is severely limited. The GMFM improved after 12 weeks of Pulsed Electromagnetic Field (PEMF) therapy, Electrical Muscle Stimulation (EMS), and physiotherapy to 38 which is Level IV of GMFCS. By Week 24, the GMFM had increased to 56%, and now was Level III GMFCS, showing great improvement in mobility and postural control, as reflected in a better sitting balance, being able to transfer independently, and use a walker to assist her with ambulation.

Table 1: GMFM & GMFCS scores at three time points

Time point	GMFM score %	GMFCS level
Baseline (Week 0)	19%	V
Post-treatment T1 (Week 12)	38%	IV
Post-treatment T2 (Week 24)	56%	III

Discussion

This study suggests evidence supporting the efficacy of Pulsed Magnetic Field (PMF) therapy coupled with EMS in children with cerebral palsy, especially in improving postural control, weight-bearing capacity, and pre-gait training. There were no adverse effects and the intervention was well tolerated making the applied dose and treatment course safe. The noted enhancements of the dynamic postural balance and functional mobility indicate that PEMF and EMS could be effective adjuncts to the conventional physiotherapeutic treatments.[8]

In line with the previous researches, Functional Electrical Stimulation (FES) along with the conventional rehabilitation methods have been found to have a significant effect on postural stability in comparison to traditional therapy. FES provides electrical stimulation in synchrony with voluntary and movement-related tasks, which facilitates relearning of motor tasks and functional activation. Conversely, Neuromuscular Electrical Stimulation (NMES) is typically utilized in order to provoke muscle contractions that do not require any voluntary work to help the muscles to strengthen, enhance the range of motion and neuromuscular re-education. The Electrical Muscle Stimulation (EMS) that was used in the current study was not similar to the conventional NMES in its application - it was utilized in non-task-specific, synchronous mode, which is mainly aimed at neuromuscular activation and re-education, but not at direct training of particular functional tasks. The literature is in favor of the NMES-based intervention to enhance the biomechanics, functional mobility, and muscular strength, which explains the therapeutic process of electrical stimulation use in neuro-rehabilitation of children.[9]

Likewise, repetitive Peripheral Magnetic Stimulation (rPMS) used together with intensive physiotherapy has also been demonstrated to improve walking velocity, ambulation, and coordination, and again indicates the potential complementary effect of magnetic and electrical stimulation in children with cerebral palsy, to maximize gait mechanics.[10]

In the present case, they manifest themselves in the gradual nature of GMFM scores (19% - 56%) and GMFCS level transition (V - III) to show that these multimodal neuro-modulatory-based interventions can also help in achieving significant functional recovery. Together, the results support the feasibility of combining highly neuro-modulatory interventions including PEMF and EMS with standard therapy in order to enhance higher functional independence and motor functioning in children with CP. To generalize these results, future studies should include larger sample sizes, longer intervention periods, and so on different exercise regimens.

Conclusion

The findings suggest that PEMF combined with EMS may be an effective intervention for improving muscle tone and enhancing motor function in children with hypotonic cerebral palsy.

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