First Congress

International Society of Diamagnetic Therapy

Diamagentic therapy in Guillain Barré syndrome

Karen Cárdenas, MD MSc SEM.Sp
Dip.S.N

13th – 14th September 2024
Magna Graecia University - Catanzaro

ISDT
International Society of Diamagnetic Therapy

UMG
ΒΡΕΤΤΙΩΝ
Dubium sapientiae initium

¿COMO SERIA EL PRONOSTICO, TIEMPO DE RECUPERACION Y SECUELAS EN EL GUILLAIN BARRÉ CON NEUROPATIA AXONAL MOTORA AGUDA INTERVENIDA CON LA TERAPIA DIAMAGNETICA DE MANERA INTEGRADA A LAS TERAPIAS INTEGRALES CONVENCIONALES?

Estadísticas del Guillain Barré

- El pronóstico de esta condición se caracteriza por una recuperación completa en aproximadamente el 80% de los casos
- 15% experimenta algún daño permanente en el nervio
- 5% de ellos quedan con secuelas sobre todo en miembros superior distal

SHORT REPORT

ABSTRACT: Patients with acute motor axonal neuropathy (AMAN) generally recover well. We reviewed clinical and electrophysiologic recovery in 13 patients for up to 5 years. Twelve patients showed rapid recovery over 12 months, whereas in the remaining one the recovery was slow and incomplete at 5 years. In AMAN, axonal degeneration appears to develop predominantly in the motor nerve terminals, and only occasionally more proximally in the nerve roots. Nerve terminal degeneration–regeneration presumably provides a mechanism for good recovery.

Muscle Nerve **35:** 793–795, 2007

TIME COURSE OF AXONAL REGENERATION IN ACUTE MOTOR AXONAL NEUROPATHY

NORIKO TAMURA, MD, SATOSHI KUWABARA, MD, SONOKO MISAWA, MD, KAZUAKI KANAI, MD, MIHO NAKATA, MD, SETSU SAWAI, MD, MASAHIRO MORI, MD, and TAKAMICHI HATTORI, MD

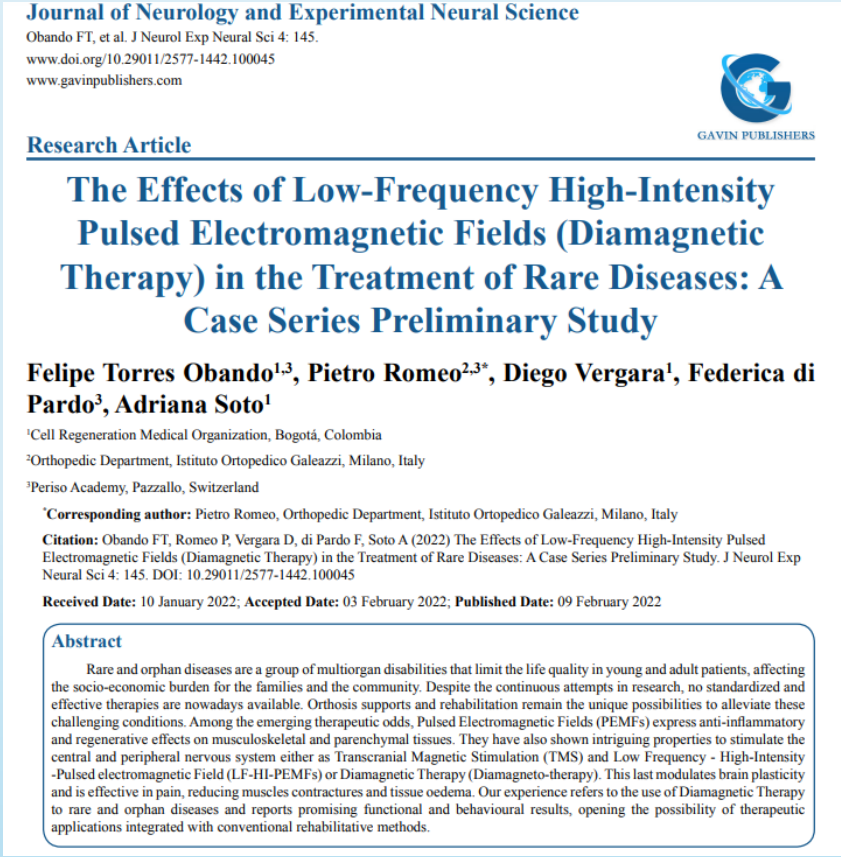
Department of Neurology, Chiba University School of Medicine, 1-8-1 Inohana, Chuo-ku, Chiba 260-8670, Japan

Neuropatía axonal motora aguda (NAMA)

- Degeneración axonal parece desarrollarse predominantemente en las terminales nerviosas motoras, y solo ocasionalmente de manera más proximal en las raíces nerviosas.
- Recuperación clínica y electrofisiológica
- 13 pacientes durante 5 años.
- 12 pacientes recuperación rápida en 12 meses
- 1 recuperación lenta e incompleta a los 5 años

Terapia Diamagnética

- Desconocemos el uso de Campos Electromagnéticos Pulsados en el manejo del Guillian Barré agudo.
- Este tipo de estimulación biofísica ya ha demostrado ser eficaz en enfermedades neurológicas, tanto en el ámbito nervioso central como periférico.
- Los PEMF expresan efectos antiinflamatorios y regenerativos en los tejidos musculoesqueléticos y parenquimatosos.
- Modula la plasticidad cerebral y es eficaz en el dolor



Journal of Neurology and Experimental Neural Science
Obando FT, et al. J Neurol Exp Neural Sci 4: 145.
www.doi.org/10.29011/2577-1442.100045
www.gavinpublishers.com

GAVIN PUBLISHERS

Research Article

The Effects of Low-Frequency High-Intensity Pulsed Electromagnetic Fields (Diamagnetic Therapy) in the Treatment of Rare Diseases: A Case Series Preliminary Study

Felipe Torres Obando[1,3], Pietro Romeo[2,3*], Diego Vergara[1], Federica di Pardo[3], Adriana Soto[1]

[1]Cell Regeneration Medical Organization, Bogotá, Colombia

[2]Orthopedic Department, Istituto Ortopedico Galeazzi, Milano, Italy

[3]Periso Academy, Pazzallo, Switzerland

[*]**Corresponding author:** Pietro Romeo, Orthopedic Department, Istituto Ortopedico Galeazzi, Milano, Italy

Citation: Obando FT, Romeo P, Vergara D, di Pardo F, Soto A (2022) The Effects of Low-Frequency High-Intensity Pulsed Electromagnetic Fields (Diamagnetic Therapy) in the Treatment of Rare Diseases: A Case Series Preliminary Study. J Neurol Exp Neural Sci 4: 145. DOI: 10.29011/2577-1442.100045

Received Date: 10 January 2022; **Accepted Date:** 03 February 2022; **Published Date:** 09 February 2022

Abstract

Rare and orphan diseases are a group of multiorgan disabilities that limit the life quality in young and adult patients, affecting the socio-economic burden for the families and the community. Despite the continuous attempts in research, no standardized and effective therapies are nowadays available. Orthosis supports and rehabilitation remain the unique possibilities to alleviate these challenging conditions. Among the emerging therapeutic odds, Pulsed Electromagnetic Fields (PEMFs) express anti-inflammatory and regenerative effects on musculoskeletal and parenchymal tissues. They have also shown intriguing properties to stimulate the central and peripheral nervous system either as Transcranial Magnetic Stimulation (TMS) and Low Frequency - High-Intensity -Pulsed electromagnetic Field (LF-HI-PEMFs) or Diamagnetic Therapy (Diamagneto-therapy). This last modulates brain plasticity and is effective in pain, reducing muscles contractures and tissue oedema. Our experience refers to the use of Diamagnetic Therapy to rare and orphan diseases and reports promising functional and behavioural results, opening the possibility of therapeutic applications integrated with conventional rehabilitative methods.

- Inhiben la transcripción de IL-6 activada por el factor proinflamatorio IL -1ª.
- Control de la inflamación mediado por los Receptores de Adenosina A2A y A3 como prevención y tratamiento de los cambios degenerativos.
- Desencadena respuestas metabólicas gracias al movimiento rápido de líquidos y solutos diamagnéticos desde el entorno extra e intracelular.
- Eficacia especialmente a frecuencias < 100 Hz en trastornos inflamatorios, así como en el alivio del dolor y la mejora de la función motora.
- La acción anti edema, los PEMF afectan la microcirculación, aumentando la perfusión microvascular.

Premi et al. BMC Neurosci (2018) 19:34
https://doi.org/10.1186/s12868-018-0434-z

BMC Neuroscience

RESEARCH ARTICLE Open Access

Modulation of long-term potentiation-like cortical plasticity in the healthy brain with low frequency-pulsed electromagnetic fields

Enrico Premi[1,2*], Alberto Benussi[2], Antonio La Gatta[3], Stefano Visconti[4], Angelo Costa[1], Nicola Gilberti[1], Valentina Cantoni[2], Alessandro Padovani[2], Barbara Borroni[2] and Mauro Magoni[1]

Abstract

Background: Non-depolarizing magnetic fields, like low frequency-pulsed electromagnetic fields (LF-PEMFs) have shown the ability to modulate living structures, principally by influencing synaptic activity and ion channels on cellular membranes. Recently, the CTU Mega 20 device was presented as a molecular accelerator, using energy up to 200 J and providing high-power (2 Tesla) pulsating fields with a water-repulsive (diamagnetic) action and tissue biostimulation. We tested the hypothesis that LF-PEMFs could modulate long-term corticospinal excitability in healthy brains by applying CTU Mega 20®. Ten healthy subjects without known neurological and/or psychiatric diseases entered the study. A randomized double-blind sham-controlled crossover design was employed, recording TMS parameters (amplitude variation of the motor evoked potential as index of cortical excitability perturbations of the motor system) before (pre) and after (post +0, +15, +30 min) a single CTU Mega 20 session on the corresponding primary right-hand motor area, using a real (magnetic field = 2 Tesla; intensity = 90 J; impulse frequency = 7 Hz; duration = 15 min) or sham device. A two-way repeated measures ANOVA with TIME (pre, post +0, +15, +30 min) and TREATMENT (real vs. sham stimulation) as within-subjects factor was applied.

Results: A significant TIME × TREATMENT interaction was found ($p < 0.001$). Post hoc comparisons showed a significant effect of TIME, with significant differences at +0, +15 and +30 min compared to baseline after real stimulation (all $p < 0.05$) but not after sham stimulation (all $p < 0.05$) and significant effects of TREATMENT, with significant differences at +0, +15 and +30 min for real stimulation compared to sham stimulation (all $p < 0.005$). No significant depolarizing effects were detected throughout the (real) stimulation.

Conclusions: Our proof-of-concept study in healthy subjects supports the idea that non-ionizing LF-PEMFs induced by the CTU Mega 20 diamagnetic acceleration system could represent a new approach for brain neuromodulation. Further studies to optimize protocol parameters for different neurological and psychiatric conditions are warranted.

Trial Registration The present work has been retrospectively registered as clinical trial on ClinicalTrials.gov NCT03537469 and publicly released on May 24, 2018

Keywords: Long-term potentiation-like cortical plasticity, Low frequency-pulsed electromagnetic fields, Diamagnetism, Neuroplasticity

- Un ensayo aleatorizado, doble ciego y controlado con placebo que ha demostrado que los PEMF de baja frecuencia no ionizantes inducidos por la CTU Mega 20 causan un Aumento de más del 60% en la excitabilidad corticoespinal en sujetos sanos

- Actividad del canal de Ca2+ y Na+ puede ser perturbada por campos magnéticos, considerando las características anisotrópicas diamagnéticas de los fosfolípidos de membrana.

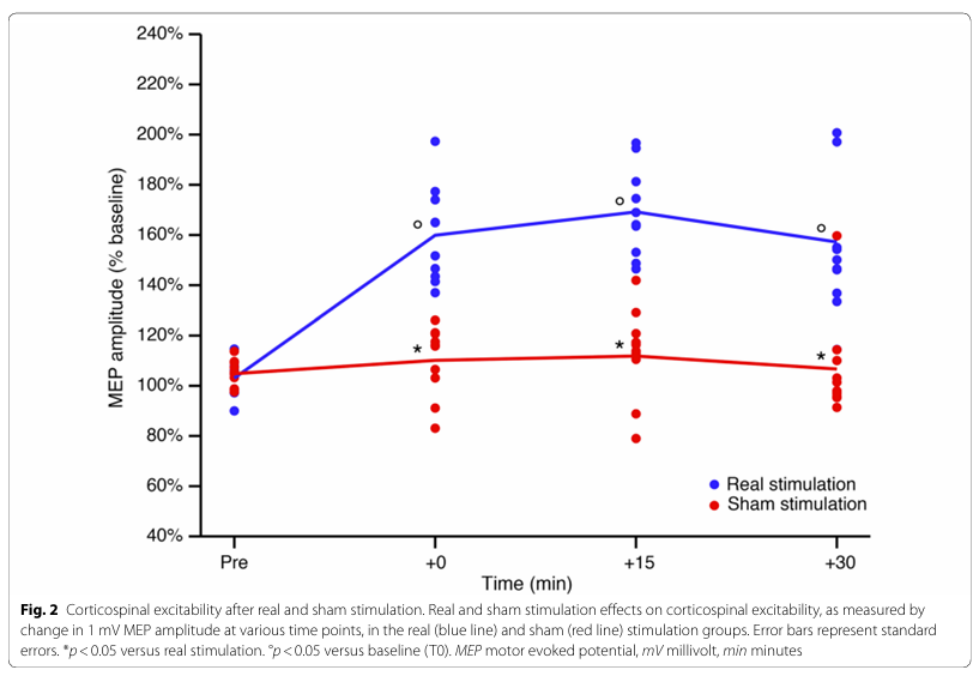


Fig. 2 Corticospinal excitability after real and sham stimulation. Real and sham stimulation effects on corticospinal excitability, as measured by change in 1 mV MEP amplitude at various time points, in the real (blue line) and sham (red line) stimulation groups. Error bars represent standard errors. *$p < 0.05$ versus real stimulation. °$p < 0.05$ versus baseline (T0). *MEP* motor evoked potential, *mV* millivolt, *min* minutes

reports

MDPI

Case Report

Diamagnetic Therapy in a Patient with Complex Regional Pain Syndrome Type I and Multiple Drug Intolerance: A Case Report

Roberta Roberti [1], Gianmarco Marcianò [1], Alessandro Casarella [1], Vincenzo Rania [1], Caterina Palleria [2], Cristina Vocca [1], Luca Catarisano [1], Lucia Muraca [1,3], Rita Citraro [1,2,4], Pietro Romeo [5,*], Giovambattista De Sarro [1,2,4] and Luca Gallelli [1,2,4,6]

[1] Department of Health Science, School of Medicine, University of Catanzaro, 88100 Catanzaro, Italy; roberta.roberti9@outlook.com (R.R.); gianmarco.marciano@libero.it (G.M.); al.cas1993@gmail.com (A.C.); raniavincenzo1@gmail.com (V.R.); cristina_vocca@live.it (C.V.); lucacatarisano@gmail.com (L.C.); lalumuraca@gmail.com (L.M.); citraro@unicz.it (R.C.); desarro@unicz.it (G.D.S.); gallelli@unicz.it (L.G.)
[2] Operative Unit of Clinical Pharmacology and Pharmacovigilance, Mater Domini Hospital, 88100 Catanzaro, Italy; palleria@unicz.it
[3] Department of Primary Care, ASP Catanzaro, 88100 Catanzaro, Italy
[4] Research Center FAS@UMG, University of Catanzaro, 88100 Catanzaro, Italy
[5] Department of Orthopedics, IRCCS Istituto Ortopedico Galeazzi, 20123 Milan, Italy
[6] Department of Health Science, School of Medicine, Medifarmagen SRL Spin Off University of Catanzaro, 88100 Catanzaro, Italy
* Correspondence: romeo.p@libero.it

Abstract: Complex regional pain syndrome (CRPS) is a neurologic chronic pain condition hard to diagnose and treat, and able to significantly impact the quality of life. Currently, the available multimodal, individualized treatments (i.e., pharmacological and non-pharmacological therapies including invasive procedures) are aimed only at symptom control. Herein, we report a 69-year-old Caucasian female who came to our attention due to a 3-year history of severe (10/10) burning pain in her right ankle, along with oedema and local changes in skin color and temperature, which occurred after the ankle sprain. Previous pharmacological attempts failed due to multiple drug intolerance. Clinical examination confirmed the CRPS type I diagnosis, and a weekly diamagnetic therapy protocol was started since the patient refused further medications and interventional procedures. After 10 weeks of treatment, a significant ($p < 0.01$) reduction in pain severity and absence of oedema (difference in ankles' circumference: from 3 cm to 0) were observed, with consequent improvements in quality of life and no adverse events. Although high-quality clinical evidence is still lacking, our case report suggests further investigating the potential use of diamagnetic therapy as a non-invasive and safe adjunctive treatment for CRPS, and as an alternative when patients did not benefit from drugs and/or refuse invasive procedures.

Keywords: algodystrophy; CRPS; drug intolerance; magnetic fields; PEMFs; physical therapy

check for updates

Citation: Roberti, R.; Marcianò, G.; Casarella, A.; Rania, V.; Palleria, C.; Vocca, C.; Catarisano, L.; Muraca, L.; Citraro, R.; Romeo, P.; et al. Diamagnetic Therapy in a Patient with Complex Regional Pain Syndrome Type I and Multiple Drug Intolerance: A Case Report. *Reports* **2022**, *5*, 18. https://doi.org/10.3390/reports5020018

Academic Editor: Toshio Hattori

Received: 9 April 2022
Accepted: 24 May 2022
Published: 26 May 2022

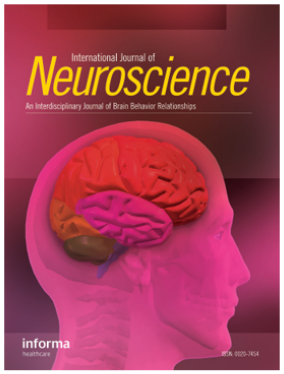
Table 1. Protocol applied during each treatment session.

Technical Specifications	Duration
Movement of liquids	
Intra L: 40-Extra H: 60	5 min
Endogenous biostimulation	
Slow fibres: Power 3	5 min
Joint	10 min
Pain control	
3 Hz	5 min

Table 2. Summary of the results.

	Outcome	Outcome Measure	Baseline	Week 10
Efficacy	**Pain**	Numeric rating scale (0–10)	10/10	2/10
	Oedema	Difference in ankle circumference	3 cm	0
	Quality of life	SF-36 questionnaire	Physical functioning: 20% Role limitations due to physical health: 0% Role limitations due to emotional problems: 0% Energy/fatigue: 30% Emotional well-being: 40% Social functioning: 25% Pain: 10% General health: 30% Health change: 50%	Physical functioning: 60% Role limitations due to physical health: 50% Role limitations due to emotional problems: 66.7% Energy/fatigue: 50% Emotional well-being: 68% Social functioning: 50% Pain: 55% General health: 45% Health change: 100%
Safety	**Adverse events**	Number and type of adverse events	None	None

informa
healthcare



Just Accepted by *International Journal of Neuroscience*

Effects of Electromagnetic Field (PEMF) Exposure at Different Frequency and Duration on the Peripheral Nerve Regeneration: in Vitro and in Vivo Study

Wei-Hong Hei, Soo-Hwan Byun, Jong-Sik Kim, Soochan Kim, Young-Kwon Seo, Joo-Cheol Park, Soung-Min Kim, Jeong Won Jahng, Jong-Ho Lee

doi:10.3109/00207454.2015.1054032

Purpose The purpose was to clarify the influence of frequency and exposure time of PEMF on the peripheral nerve regeneration.
Materials and methods Immortalized rat Schwann cells (iSCs) (1×10^2/well) were exposed at 4 different conditions in 1mT (50Hz 1Hr/day, 50Hz 12Hr/day, 150Hz 1Hr/day and 150Hz 12Hr/day). Cell proliferation, mRNA expression of S100 and brain-derived neurotrophic factor (BDNF) were analyzed. Sprague-Dawley rats (200–250g) were divided into 6 groups (n $\mathcal{D}$ 10 each): control, sham, 50Hz 1Hr/day, 50Hz 12Hr/day, 150Hz 1Hr/day and 150Hz 12Hr/day. Mental nerve was crush-injured and exposed at 4 different conditions in 1mT (50Hz 1Hr/day, 50Hz 12Hr/day, 150Hz 1Hr/day and 150Hz 12Hr/day). Nerve regeneration was evaluated with functional test, histomorphometry and retrograde labeling of trigeminal ganglion.
Results iSCs proliferation with 50Hz, 1Hr/day was increased from 4th to 7th day; mRNA expression of S100 and BDNF was significantly increased at the same condition from 1st week to 3rd week ($p<.05$, vs. control); Difference score was increased at the 2nd and 3rd week, and Gap score was increased at the 3rd under 50Hz 1Hr PEMF compared with control while other conditions showed no statistical meaning. Axon counts and retrograde labeled neurons were significantly increased under PEMF of 4 different conditions compared with control. Although there was no statistical difference, 50 Hz, 1Hr PEMF showed highest regeneration ability than other conditions.
Conclusion PEMF enhanced peripheral nerve regeneration, and that it may be due to cell proliferation and increase in BDNF and S100 gene expression.

Publicación electrónica 5 de junio de 2023.

WILEY Full Text Article

Los campos electromagnéticos pulsados mejoraron la regeneración de los nervios periféricos tras una reparación retrasada de un mes

Zhu Keyan [1,2], Zhang Liqian [1], Xu Xinzhong [1], Jing Juehua [1], Xu Chungui [1]

Afiliaciones + expandir

Identificador de la empresa: 37277911 Documento de la investigación: 10.1002/bem.22443

COMPORTAMIENTO

Citar

Colecciones

COMPARTIR

Abstracto

El objetivo de este estudio fue determinar si los campos electromagnéticos pulsados (PEMF) postoperatorios podrían mejorar la rehabilitación neuromuscular después de la reparación tardía de lesiones de nervios periféricos. Treinta y seis ratas Sprague-Dawley se dividieron aleatoriamente en un grupo simulado, un grupo de control y un grupo de PEMF. Se seccionaron los nervios ciáticos, excepto en el grupo de control. Un mes después, se reconectaron los extremos nerviosos de los dos primeros grupos. El grupo de ratas PEMF se sometió a PEMF a partir de entonces. El grupo de control y el grupo simulado no recibieron tratamiento. Cuatro y ocho semanas después, se midieron los cambios morfológicos y funcionales. Cuatro y ocho semanas después de la operación, en comparación con el grupo simulado, los índices funcionales ciáticos (SFI) del grupo PEMF fueron más altos. Más axones se regeneraron distalmente en el grupo PEMF. Los diámetros de las fibras del grupo PEMF fueron mayores. Sin embargo, los diámetros de los axones y los espesores de mielina no fueron diferentes entre estos dos grupos. Las expresiones del factor neurotrófico derivado del cerebro y del factor de crecimiento endotelial vascular fueron mayores en el grupo de PEMF después de 8 semanas. El análisis de IOD semicuantitativo para la intensidad de la tinción positiva indicó que había más BDNF, VEGF y NF200 en el grupo de PEMF. Se concluye que los PEMF tienen efecto sobre la regeneración axonal después de una reparación nerviosa tardía de un mes. Las expresiones reguladas al alza de BDNF y VEGF pueden desempeñar un papel en este proceso. © 2023 Sociedad de Bioelectromagnética.

NAVEGACIÓN DE PÁGINA

- Título y autores
- Abstracto
- Artículos similares
- Citado por
- Referencias
- Términos MeSH
- Sustancias

El PEMF mejoró la regeneración de los nervios periféricos y esto puede deberse a la proliferación celular y al aumento de la expresión de los genes BDNF y S100.

ISDT International Society of Diamagnetic Therapy

- 10% permitieron el crecimiento máximo de neurita
- Aumenta la expresión génica de los marcadores de expresión neuronal Neu N y Tuj-1 y el factor de transcripción Ngn1.
- Disminuye la expresión de los genes IL-1 e IL-8
- Disminuye la liberación de citocinas TNF e IL-8 en células diferenciadas M1
- Aumenta IL-1, y la expresión del gen CD206, así como la liberación de la citocina IL-10 en células M.

KeAi
CHINESE ROOTS GLOBAL IMPACT

Contents lists available at ScienceDirect

Engineered Regeneration

journal homepage: http://www.keaipublishing.com/en/journals/engineered-regeneration/

Pulsed electromagnetic field stimulation enhances neurite outgrowth in neural cells and modulates inflammation in macrophages

Francesco Fontana[a,b,*], Andrea Cafarelli[a,b], Francesco Iacoponi[a,b], Soria Gasparini[a,b], Tiziano Pratellesi[c], Abigail N. Koppes[d,e,f], Leonardo Ricotti[a,b]

[a] The BioRobotics Institute, Scuola Superiore Sant'Anna, 56127 Pisa, Italy
[b] Department of Excellence in Robotics & AI, Scuola Superiore Sant'Anna, 56127 Pisa, Italy
[c] BAC Technology s.r.l., 50063 Florence, Italy
[d] Department of Chemical Engineering, Northeastern University, Boston, MA 02115, USA
[e] Department of Bioengineering, Northeastern University, Boston, MA 02115, USA
[f] Department of Biology, Northeastern University, Boston, MA 02115, USA

ARTICLE INFO

Keywords:
Nerve regeneration
Biophysical stimulation
Pulsed electromagnetic fields (PEMF)
Neurite outgrowth
Anti-inflammatory
Peripheral nerve injuries

ABSTRACT

Nerve regeneration following traumas remains an unmet challenge. The application of pulsed electromagnetic field (PEMF) stimulation has gained traction for a minimally invasive regeneration of nerves. However, a systematic exploration of different PEMF parameters influencing neuron function at a cellular level is not available. In this study, we exposed neuroblastoma F11 cells to PEMF to trigger beneficial effects on neurite outgrowth. Different carrier frequencies, pulse repetition frequencies, and duty cycles were screened with a custom *ad hoc* setup to find the most influential parameters values. A carrier frequency of 13.5 MHz, a pulse repetition frequency of 20 Hz, and a duty cycle of 10% allowed maximal neurite outgrowth, with unaltered viability with respect to non-stimulated controls. Furthermore, in a longer-term analysis, such optimal conditions were also able to increase the gene expression of neuronal expression markers NeuN and Tuj-1 and transcription factor Ngn1. Finally, the same optimal stimulation conditions were also applied to THP-1 macrophages, and both pro-inflammatory (TNF-α, IL-1β, IL-6, IL-8) and anti-inflammatory cytokines (IL-10, CD206) were analyzed. The optimal PEMF stimulation parameters did not induce differentiation towards an M1 macrophage phenotype, decreased IL-1β and IL-8 gene expression, decreased TNF-α and IL-8 cytokine release in M1-differentiated cells, increased IL-10 and CD206 gene expression, as well as IL-10 cytokine release in M0 cells. The specific PEMF stimulation regime, which is optimal *in vitro*, might have a high potential for a future *in vivo* translation targeting neural regeneration and anti-inflammatory action for treating peripheral nerve injuries.

PROPUESTA

- Partiendo de esta base, se ha propuesto un protocolo integral con tecnologías que han dado buen resultado y quisimos potencializar estas respuesta con la CTU Mega 20 como opción terapéutica sinérgica con una probable ruta mas corta de recuperación dada la larga respuesta tras los tratamientos rehabilitadores convencionales.

GUILLAIN BARRÉ (NAMA) neuropatía axonal motora aguda

Paciente 1

- Masculino
- 32 años
- Variante axonal
- ELM-NCD 4 extremidades: polineuropatía de las 4 extremidades motora activa con compromiso axonal con signos de denervación en las 4 extremidades proximales y distales.
- UCI:
- Inmunoglobulina Humana x 5 días
- EVA: 8/10
- Edema MI Y MS
- Compromiso músculos respiratorios

Paciente 2

- Femenino
- 27 años
- Variante axonal
- ELM-NCD 4 extremidades: polineuropatía de las 4 extremidades motora activa con compromiso axonal con signos de denervación en las extremidades inferiores proximales y distales.
- UCI:
- Inmunoglobulina Humana x 5 días
- EVA: 8/10
- Edema MI
- Compromiso músculos respiratorios

Protocolo Integral

- CTU Mega 20: 10 sesiones + Medicina hiperbárica: 10 sesiones continuas
- Descanso de 1 semana
- CTU s WAVE: 10 sesiones + medicina hiperbárica: sesiones continuas
- 10 sesiones de ejercicio terapéutico por médico del deporte
- Descanso de 1 semana
- CTU s WAVE: 10 sesiones + ejercicio terapéutico médico del deporte

- **10 Terapias físicas**
- **10 Terapias Ocupacionales**
- **Ejercicio de fuerza**
- **Proteína Whey**
- **Probióticos y prebióticos**
- **BCAA**

CTU Mega 20

- Transcraneal: frontal, temporal y parietal
- Paín control: Noc - Neu
- Estimulación de fibras lentas nerviosas
- Estimulación de fibras rápidas nerviosas
- Movimiento de líquidos E:H -I:H – E:L –I:H
- RF: 3-4 en palmas y plantas

CTU S WAVE

- Disco desfocalizado
- Miembros superiores, inferiores y tronco
- Disgregante: H
- Drenante: H
- Estimulante: H
- Disparos: 240 por zona

frontiers | Frontiers in Neurology

TYPE Review
PUBLISHED 17 August 2022
DOI 10.3389/fneur.2022.963849

OPEN ACCESS

EDITED BY
John M. Solomon,
Manipal Academy of Higher Education, India

REVIEWED BY
Francesco Agostini,
Sapienza University of Rome, Italy
Wen Wu,
Southern Medical University, China

*CORRESPONDENCE
Yuewen Ma
yuewen_m@126.com

SPECIALTY SECTION
This article was submitted to Neurorehabilitation, a section of the journal Frontiers in Neurology

RECEIVED 08 June 2022
ACCEPTED 21 July 2022
PUBLISHED 17 August 2022

CITATION
Guo J, Hai H and Ma Y (2022) Application of extracorporeal shock wave therapy in nervous system diseases: A review. *Front. Neurol.* 13:963849. doi: 10.3389/fneur.2022.963849

Application of extracorporeal shock wave therapy in nervous system diseases: A review

Juan Guo, Hong Hai and Yuewen Ma*

Department of Rehabilitation Medicine, The First Affiliated Hospital of China Medical University, Shenyang, China

Neurological disorders are one of the leading causes of morbidity and mortality worldwide, and their therapeutic options remain limited. Recent animal and clinical studies have shown the potential of extracorporeal shock wave therapy (ESWT) as an innovative, safe, and cost-effective option to treat neurological disorders. Moreover, the cellular and molecular mechanism of ESWT has been proposed to better understand the regeneration and repairment of neurological disorders by ESWT. In this review, we discuss the principles of ESWT, the animal and clinical studies involving the use of ESWT to treat central and peripheral nervous system diseases, and the proposed cellular and molecular mechanism of ESWT. We also discuss the challenges encountered when applying ESWT to the human brain and spinal cord and the new potential applications of ESWT in treating neurological disorders.

KEYWORDS

extracorporeal shock wave therapy, peripheral nervous system diseases, central nervous system diseases, mechanotransduction, cost-effectiveness, neural tissue regeneration

TABLE 1 Summary of the applications of ESWT in CTS.

Treatment	Group mode	Study design	Reference	Intervention and ESWT Protocol	Follow-up	Outcome
rESWT	wrist splint group ($n = 47$), splint+rESWT group ($n = 47$), rESWT group ($n = 45$), splint+ placebo rESWT group ($n = 50$)	RCT	71	– ESWT (1,000 shocks, 0.05 mJ/mm^2 at 5 Hz; 3 sessions, 1 week between sessions) – wrist splint	3 months	Pain and functionality significantly improved in ESWT groups; A more remarkable improvement in the hand function and electrophysiological measures was observed in the group with ESWT and a combined wrist splint.
ESWT	ESWT group ($n = 30$), Local corticosteroid injection (LCI) group ($n = 25$)	RCT	72	– ESWT (1,000 shocks, 1.5 bar at 6 Hz; 3 sessions, 1 week between sessions) – LCI	3 weeks 9 weeks 12 weeks	Pain, function and median nerve sensory nerve action potential distal latency improved in the 9 and 12-week follow-ups for the ESWT group.
rESWT	single dose rESWT group (n = 13), LCI group (n = 12)	RCT	73	– ESWT (5,000 shocks, 4 bar at 15 Hz; 1 session) – LCI	1 week 4 weeks 12 weeks 24 weeks	Significantly greater improvement in symptom severity, functionality and pain at weeks 12 to 24 in the rESWT group.
fESWT	60 patients with CTS were examined in ESWT group and control group	RCT	74	– ESWT (800–1,100 shocks, 0.05–0.15 energy; 4 sessions, 1 week between sessions) – Conservative treatment including wrist splint; nonsteroidal anti-inflammatory drugs; Vitamin B1	3 months 6 months.	Pain and function significantly improved in the ESWT group after 3 months and 6 months of treatment.
fESWT	shock wave group ($n = 34$), nutraceutical group ($n = 26$)	RCT	75	– ESWT (1,600 shocks, 0.03 mJ/mm^2 at 4 Hz; 3 sessions, 1 week between sessions) -Nutraceuticals composed of ALA, GLA, and Echinacea	6 months	ESWT provided an improvement comparable to nutraceuticals on pain and functional ability in patients with CTS.

ESWT, extracorporeal shock wave therapy; fESWT, focused extracorporeal shock wave therapy; rESWT, radial extracorporeal shock wave therapy; CTS, Carpal Tunnel Syndrome; RCT, randomized clinical trial; LCI, Local corticosteroid injection; ALA, α-Linolenic acid; GLA, γ-linolenic acid.

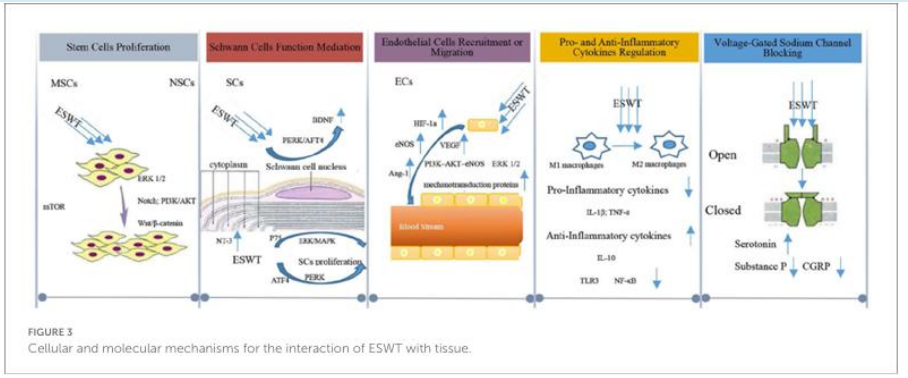


FIGURE 3
Cellular and molecular mechanisms for the interaction of ESWT with tissue.

Protocolos

Medicina hiperbárica

- 1 sesión por día
- 10 sesiones con un período de descanso de 2 días entre cada ciclo.
- 60 min a 220 kPa con 10 minutos de compresión y descompresión.
- 30 sesiones de total

Ejercicio terapéutico dirigido

- **Modalidad:** ejercicios polimotores, pesas libres, calistenia, bandas elásticas, ejercicio funcional.
- **Intensidad:** moderada, progresando hasta el 70-80 % de 1 RM (calculado con el método de Lander).
- **Carga:** 4-6 series de 12-15 repeticiones
- **Ritmo:** 2=2=2 progresando hasta 5=5=5.
- **Densidad:** 30-60 segundos.

Diving and Hyperbaric Medicine Volume 50 No. 3 September 2020 303

Hyperbaric oxygen treatment in a patient with Guillain-Barré syndrome receiving mechanical ventilation

Lisha Song[1], Baopeng Xing[1], Weimin Yang[1], Haifeng Li[1]

[1] *Department of Emergency, The First Hospital of Jilin University, Changchun, Jilin, 130021, China*

Corresponding author: *Dr Haifeng Li, Department of Emergency, The First Hospital of Jilin University, Changchun, Jilin, 130021, China*
lll558@hotmail.com

Key words
Spinal cord injury; Neurology; Intensive care medicine; Case reports

Abstract

(Song L, Xing B, Yang W, Li H. Hyperbaric oxygen treatment in a patient with Guillain-Barré syndrome receiving mechanical ventilation. Diving and Hyperbaric Medicine. 2020 September 30;50(3):303–305. doi: 10.28920/dhm50.3.303-305. PMID: 32957136.)

The mortality rate of patients with Guillain-Barré syndrome (GBS) who develop respiratory muscle paralysis and need mechanical ventilation is increased. Though an unestablished indication, hyperbaric oxygen treatment (HBOT) has been used to treat patients with mild GBS who do not have respiratory muscle paralysis. The use of HBOT in severe cases has not been reported. We present a patient with severe GBS who received HBOT while ventilated in a multiplace hyperbaric chamber. Three courses of HBOT (one session per day, 10 sessions per course) were administered with a 2-day rest period between each course. The HBOT protocol was 40 minutes at 220 kPa with 25 minutes of compression and decompression. Following weeks of gradual deterioration, motor function improved after the first HBOT session. After eight HBOT sessions, the patient was successfully discontinued from mechanical ventilation and after 10 sessions the patient's muscle strength was significantly improved. After 30 HBOT sessions, the patient had normal breathing and speech, and did not cough when eating. Upper limb muscle strength was graded as 4 on the Medical Research Council (MRC) scale, lower limb muscle strength was graded as MRC 3. The patient was successfully discharged. Mechanically ventilated GBS patients may benefit from HBOT but studies are required to separate spontaneous recovery rates from treatment benefit.

- PTE con SGB grave , ventilado CH multiplaza.
- 1 sesión día, 10 sesiones con un período de descanso de 2 días entre cada ciclo.
- 40 min a 220 kPa con 25 minutos de compresión y descompresión.
- 1 sesión: Función motora mejoró
- 8: sin ventilación mecánica
- 10: Fuerza muscular mejoró significativamente
- 30: Fuerza MMSS 4/4 MSIS 3/4

Hindawi
Autoimmune Diseases
Volume 2021, Article ID 6627779, 9 pages
https://doi.org/10.1155/2021/6627779

Research Article

Protective Effect of Hyperbaric Oxygen Treatment on Axon Degeneration after Acute Motor Axonal Neuropathy

Ni Komang Sri Dewi Untari,[1,2,3,4] Kurnia Kusumastuti,[5] Guritno Suryokusumo,[6] and I Ketut Sudiana[7]

[1]*Department of Hyperbaric, Drs. Med. Rijadi S. Phys. Naval Health Institute, Surabaya, Indonesia*
[2]*Department of Neurology, Faculty of Medicine, Hang Tuah University, Surabaya, Indonesia*
[3]*Department of Neurology, Dr. Ramelan Navy Hospital, Surabaya, Indonesia*
[4]*Hyperbaric Medicine, Basic Medical Science, Airlangga University, Surabaya, Indonesia*
[5]*Department of Neurology, Faculty of Medicine, Airlangga University, Surabaya, Indonesia*
[6]*Department of Hyperbaric, Faculty of Medicine, Pembangunan Nasional University, Jakarta, Indonesia*
[7]*Department of Pathology Anatomy, Faculty of Medicine, Airlangga University, Surabaya, Indonesia*

Correspondence should be addressed to Ni Komang Sri Dewi Untari; komang_neuro@yahoo.com

Received 3 January 2021; Revised 22 September 2021; Accepted 4 October 2021; Published 8 November 2021

Academic Editor: MOACYR REGO

- Disminuye la degeneración axonal y restaura los tejidos y el estado motor.
- Desencadena actividad del glutatión.
- Aumentar IL-1β
- Efecto protector sobre la degeneración axonal de la médula espinal y el nervio ciático AMAN.

RESULTADOS

- Recuperación de la movilidad con ayuda externa como caminadores y muletas al mes del tratamiento.
- Recuperación de la movilidad generalizada los 4 meses con ayuda externa.
- Mejora de la fuerza muscular de los miembros superiores con aumento de la motricidad gruesa y fina a los 4 meses.
- Mejora del dolor 8/10 a 1/10 en el primer mes de tratamiento, reducción del 70%
- Demuestra ser 66.66% más rápido que los métodos convencionales.
- Demuestra una recuperación 93.33 % secuela más severa de esta variante.
- Prevención de síntomas duraderos, dolor crónico y discapacidad que afectan negativamente, a su vez, la calidad de vida.
- No uso de medicamentos como corticoides sistémicos, AINES.
- Menor número de terapias física, ocupacional, respiratoria.
- Menor riesgo de depresión, ansiedad, trastornos del sueño.
    - Nuestros pacientes refieren tener un estado del animo estable cuando asisten a sus tratamientos.
- Reintegro a su trabajo a los 4 meses posterior al tratamiento.

ISDT
International Society of Diamagnetic Therapy

13th – 14th September 2024

UMG
Dubium sapientiae initium

CONCLUSIONES

APPLICATION OF REGENERATIVE TECHNOLOGIES IN GUILLAIN BARRÉ, A CASE REPORT

Karen Cardenas[1], Angie Bedoya[2], Jeidys Bravo[2], Orlando Angulo[3]*

[1]Renacerá ips sede AMBY.
[2]Universidad Cooperativa de Colombia, sede Villavicencio
[3]Professor and researcher at Universidad Cooperativa de Colombia, sede Villavicencio
*Corresponding author, orlando.angulo@campusucc.edu.co ORCID 0000-0003-0920-3886

- Nuestra experiencia se refiere al uso de la Terapia Diamagnética en la enfermedad del Guillain Barré con neuropatía axonal motora aguda el cual reporta resultados funcionales, comportamentales y del manejo de dolor prometedores, abriendo la posibilidad de aplicaciones terapéuticas integradas con los métodos rehabilitadores convencionales.
- Confirma la posibilidad teórica de utilizar tratamientos complementarios en estas enfermedades. Por otra parte, hay que considerar que la inflamación crónica jugaría un papel importante en las secuelas y tiempos de recuperación
- Una intervención temprana desde el día 1 de hospitalización, podrían demostrar una recuperación más rápida y se podría hablar de una menor probabilidad de complicaciones o secuelas a largo plazo
- CTU Mega 20 es capaz de inducir la reorientación magnética de los fosfolípidos de membrana y, en consecuencia, inducir un efecto biológico en la función del sistema nervioso
- Este reporte aumenta la potencialidad de la estimulación diamagnética como un nuevo enfoque para la neuromodulación.
- No se observaron efectos secundarios en ninguno de los sujetos tratado
- Se requieren más estudios

ISDT
International Society of Diamagnetic Therapy

13th – 14th September 2024

UMG
Dubium sapientiae initium