Research indicates that PEMF therapy can successfully induce nerve repair. In a 1993 study by the Bioelectromagnetics Society, researchers found that rats recovered more quickly from sciatic nerve injury when they were pre-treated with PEMF therapy. While the mechanism behind this effect remains unknown, these findings offer hope to patients coping with nerve damage or degeneration.

International Journal of Surgery

Volume 12, Issue 12, December 2014, Pages 1278-1285

Original research

Pulsed electromagnetic fields accelerate functional recovery of transected sciatic nerve bridged by chitosan conduit: An animal model study

RahimMohammadi[a] DarabFaraji[b] HaniehAlemi[b] AramMokarizadeh[c]

Show more

https://doi.org/10.1016/j.ijsu.2014.11.004

Highlights

- Effect of body exposure to pulsed electromagnetic fields on transected nerve regeneration was assessed.
- Body exposure to PEMF improved functional recovery and morphometric indices of sciatic nerve.
- PEMF combined with chitosan grafting could be an effective, safe and tolerable treatment in clinical practice.

Abstract

Introduction: Effect of whole body exposure to pulsed electromagnetic fields (PEMF) on nerve regeneration in a rat sciatic nerve transection model was assessed. **Methods**: Sixty male white Wistar rats were divided into four experimental groups (n = 15), randomly: In transected group (TC) left sciatic nerve was transected and stumps were fixed in adjacent muscle. In chitosan group (CHIT) the defect was bridged using a chitosan conduit filled with phosphate-buffered saline. In treatment group (CHIT/PEMF) the whole body was exposed to PEMF (0.3 mT, 2 Hz) for 4 h/day within 1–5 days. In normal control group (NC) sciatic nerve was only dissected and manipulated. Each group was subdivided into three subgroups of five animals each and nerve fibers were studied 4, 8 and 12 weeks after surgery. **Results**: Behavioral, functional, electrophysiological, biomechanical, gastrocnemius muscle mass findings and morphometric indices confirmed faster recovery of regenerated axons in CHIT/PEMF than in CHIT group ($p < 0.05$). Immunohistochemical reactions to S-100 in CHIT/PEMF were more positive than that in CHIT group. **Discussion**: Whole body exposure to PEMF improved functional recovery and morphometric indices of sciatic nerve. Detailed mechanism of neuroprotective action remains to be investigated. **Conclusion**: PEMF combine with chitosan grafting could be considered as an effective, safe and tolerable treatment for peripheral nerve repair in clinical practice.

https://www.sciencedirect.com/science/article/pii/S1743919114009649

Submitted by Fatemeh Saberia, Samad Jahandideh

Department of Medical physics and Bio-medical Engineering, Shiraz University of Medical Sciences, Shiraz, Iran

During recent years, due to different devices used in industry an increment in the number of investigations related to Electromagnetic Field (EMF) effects composed of a wide range of parameters such as polarization, exposure duration, and exposure profiles has been reported to affect biological systems in the field of bioelectromagnetics [Anderson, 1993; Cleary, 1993; Frey, 1993; Hong, 1995], but so far no agreement on the effect of different parameters in experimental designs in relation to exposure conditions have been reached.

Up to now, so many investigations have been reported in relation to physical mechanisms of EMF's bioeffecs [Binhi, 2006; Binhi, 2007; Vincze et al., 2008; Liboff, 2009; Muehsam and Pilla,2009a; Muehsam and Pilla 2009b]. On the other hand, although a huge number of researches have been done in the field of bioelectromagnetics, but no specific database has been designed to facilitate search for collecting specific databases in the specific subjects, such as effect of EMF on mutagenesis, cell proliferation, apoptosis and so on, to analyze obtained results. A well-known example of such database is Protein Data Bank (PDB) in the field of bioinformatics. The PDB archive contains information about experimentally-determined structures of proteins, nucleic acids, and complex assemblies [Berman et al., 2002].

Recently we published two papers based on a collected database including all experiments on melatonin excretion patterns in the rat exposed to EMF [Jahanndideh et al., 2010; Jahandideh and Abdolmaleki, In press]. In these papers effect of EMF on melatonin excretion patterns were analyzed and predicted using algorithmic and non-algorithmic predictor models which showed valuable results. Such predictor models are promising and may play a useful role in defining guidelines for experimental designs relating to exposure conditions.

In conclusion, analysis and establish of predictor models on the bioelectromagnetic data could result in finding a relationship between the exposure conditions and different biological processes. This could in turn be useful in the development of treatments for some diseases by recognizing the possible positive effects of EMF. In addition, understanding how different magnitudes of

electromagnetic fields affect the biological systems could help identify the harmful effects of naturally occurring electromagnetic fields on living organisms.

Dr. Jahandideh contact information: Tel: 0098-917-7372417, jahandideh@sums.ac.ir

REFERENCES

Anderson LE. 1993. Biological effects of extremely low-frequency electromagnetic fields: In vivo studies. Am Ind Hyg Assoc J 54:186–196.

Berman HM, Battistuz T, Bhat TN, Bluhm WF, Bourne PE, Burkhardt K et al. 2002. The Protein Data Bank. Acta Crystallog Sect D 58:899–907.

Binhi VN, Rubin AB. 2007. Magnetobiology: the kT paradox and possible solutions. Electromagn. Biol. Med. 26(1):45-62.

Binhi VN. 2006. Stochastic dynamics of magnetosomes and a mechanism of biological orientation in the geomagnetic field. Bioelectromagnetics 27(1):58-63.

Cleary SF. 1993. A review of in vitro studies: Low-frequency electromagnetic fields. Am Ind Hyg Assoc J 54:178–185.

Frey AH. 1993. Electromagnetic field interactions with biological systems. FASEB J 7:272–281.

Hong FT. 1995. Magnetic field effects on biomolecules, cells, and living organisms. Biosystems 36:187–229.

Jahandideh S, Abdolmaleki P, Movahedi MM. 2010. Comparing performances of logistic regression and neural networks for predicting melatonin excretion patterns in the rat exposed to ELF magnetic fields. Bioelectromagnetics 31:164–171.

Jahandideh S, Abdolmaleki P. Prediction of melatonin excretion patterns in the rat exposed to ELF magnetic fields based on support vector machine and linear discriminant analysis. Micron (In press)
Muehsam DJ, Pilla AA. 2009a. A Lorentz model for weak magnetic field bioeffects: part I--thermal noise is an essential component of

AC/DC effects on bound ion trajectory. Bioelectromagnetics 30(6):462-75.

Muehsam DJ, Pilla AA. 2009b. A Lorentz model for weak magnetic field bioeffects: part II--secondary transduction mechanisms and measures of reactivity. Bioelectromagnetics 30(6):476-88.

Liboff AR. 2009. Electric polarization and the viability of living systems: ion cyclotron resonance-like interactions. Electromagn. Biol. Med. 28(2):124-34.

Vincze G, Szasz A, Liboff AR. 2008. New theoretical treatment of ion resonance phenomena. Bioelectromagnetics 29(5):380-386.

BIO ELECTRO MAGNETICS BEMS

Article

Pretreatment of rats with pulsed electromagnetic fields enhances regeneration of the sciatic nerve

Dr. Martin Kanje

Ana Rusovan

Betty Sisken

Göran Lundborg

First published: **1993**

https://doi.org/10.1002/bem.2250140407

Abstract

Regeneration of the sciatic nerve was studied in rats pretreated in a pulsed electromagnetic field (PEMF). The rats were exposed between a pair of Helmholtz coils at a pulse repetition rate of 2 pps at a field density of 60 or 300 μT. The PEMF treatment was then discontinued. After an interval of recovery, regeneration of the sciatic nerve was initiated by a crush lesion. Regeneration of sensory fibers was measured by the “pinch test” after an additional 3–6 days. A variety of PEMF pretreatments including 4 h /day for 1–4 days or exposure for 15 min/day during 2 days resulted in an increased regeneration distance, measured 3 days after the crush lesion. This effect could be demonstrated even after a 14-day recovery period. In contrast, pretreatment for 4 h/day for 2 days at 60 μT did not affect the regeneration distance. The results showed that PEMF pretreatment conditioned the rat sciatic nerve in a manner similar to that which occurs after a crush lesion, which indicates that PEMF affects the neuronal cell body. However, the mechanism of this effect remains obscure.

https://onlinelibrary.wiley.com/doi/abs/10.1002/bem.2250140407