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Parkinson, Pico-Tesla TMS and MEG

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COLUMN ARTICLE

Biomagnetic measurements were performed in our lab using a whole-head 122-channel MEG gradiometer device (Neuromag-122, Neuromag Ltd. Helsinki, Filand). Recordings were taken in an electromagnetically shielding room with sampling frequency rate at 256Hz and associated Nyquist frequency 128Hz. The MEG signals were filtered with cut-off frequencies at 0.3 and 40Hz. All patients were referred to our lab, by practicing neurologists and informed consent was obtained from all of them prior to the procedure. The research protocols were approved by our Research Committee of the Democritus University of Thrace. Funding for this research was provided by a collaboration of the General Secretariat of Research and Technology, GR and ERGO AEBE, INC, GR under a research program (Grant Number:80623). All patients met the UK Parkinson disease Brain Bank Criteria [1].

In addition, using Transcranial Magnetic Stimulation (TMS), which is a non-invasive method, easy to perform, we can use to investigate a variety of clinical conditions. Thus, using Anninos and Tsagas electronic device [2] it was found that we can increased the (2 - 7Hz) frequencies of the recorded MEG of each Parkinson patient towards frequencies of less or equal to its frequencies of the alpha frequency range (8 - 13Hz). The pico-Tesla (pT) (1pT=10^{-12} Tesla) external transcranial magnetic stimulation (pT-TMS) electronic device is a modified helmet containing up to 122 coils which are arranged in 5 array groups, so as to cover frontal, vertex, right and left temporal, right and left parietal and occipital area of each patient [2]. The pT-TMS device was configured for each individual to generate a square wave so as to resemble the firing activity of neurons in the brain modulated magnetic field at the individual's mean peak alpha frequency - generated in the subject's occipital lobe (Figure 1).

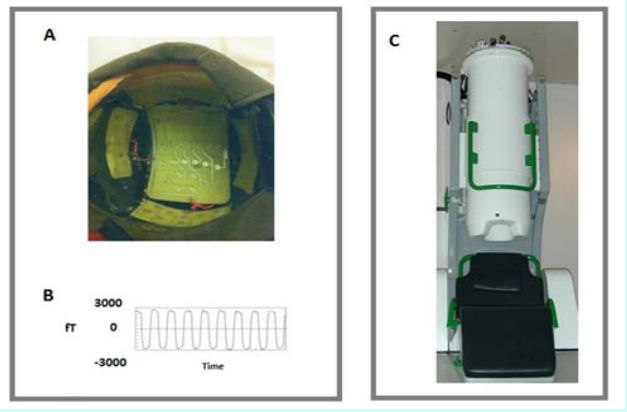

Figure 1: A) The configuration of the stimulation coils within the helmet of the electronic device. B) The frequency output from the electronic device which has calibrated to 9Hz. C) The MEG 122-channel biomagnetometer located in our lab.

In a number of studies using the pT-TMS electronic de-

vice in Parkinson patients with abnormal MEG activity we have demonstrated that patients were shown some quantifiable benefit. Thus, using external weak pT-TMS we were able successfully to attenuate most of the symptoms in a cohort of over 100 Parkinson patients [3-8]. Specifically, the patients reported marked relaxation, complete disappearance of muscular ache, their facial expression returned to normal, tremors disappeared. They also reported feeling less stiff, their gait was improved and they showed minimal akinesia [3-8].

The mechanisms by which the application of the magnetic fields attenuated the Parkinson patient's symptoms are unknown. However, one possible explanation is that these fields have been shown to influence the activity of the pineal gland which regulate the dopaminergic, and the endogenous opioid functions. Moreover, on the cellular level, magnetic fields have shown to influence the properties and stability of biological membranes as well as their transport characteristics including the intra-and extracellular distributions and flux of calcium ions [3-8].

In our research studies, we have concluded that this method of the pico Tesla TMS has the potential to be an important, non-invasive, safe, and efficacious modality in the management of patients suffering with Parkinson disease [3-8].

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