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Application of Z-score LORETA Neuro-feedback in Therapy of Epilepsy

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Editorial

Unfortunately despite major progress in the treatment of epilepsy approximately 30% of patients are still refractory to medical therapy. Surgical treatment may be an option for some of those patients, however many may not be interested or eligible. There is a demand to develop alternative treatments which would offer substantial reduction of seizures and improve quality of life. Currently a mainstay of therapy in epilepsy is pharmacological. Multiple medications are available on the market for different types of epilepsy. Some of these are broad-spectrum medications which cover both primary generalized and secondary generalized epilepsy. Other relatively narrow spectrum medications are effective mostly for certain types of epilepsy. The patients with epilepsy who do not respond to pharmacological treatment are classified as medically refractory. In these cases other forms of therapy need to be applied in order to reduce frequency of seizures. In the pediatric population the ketogenic diet has been found to be effective in reducing seizure numbers in selected patients [1]. Surgical options include minor surgery such as vagus nerve stimulator implantation [2], or major surgery including lesion resection [3].

A decrease of seizures after enhancement of the sensory motor rhythm (SMR) in patients with poorly controlled epilepsies was reported in 1972 for the first time by Dr. Sterman and his group [4,5]. This EEG based biofeedback also called neurofeedback (NFB) has been subsequently found to be an effective treatment modality in patients who do not respond to pharmacological treatment. Dr. Sterman's NFB experiments which have proven the effectiveness of SMR entrainment in epilepsy treatment [6,7] were based on the use of systems utilizing one or two NFB sensors. Approximately 60% seizure frequency reduction was noted in clinical studies with SMR entrainment. One or two sensor based NFB therapy required in many instances 50 or more NFB sessions in order to achieve the therapeutic goals.

Currently newer NFB protocols based on modernized equipment are being tested for effectiveness in the treatment of epilepsy hoping that similar therapeutic results could be reached in fewer number of NFB sessions. One of the potential candidates is Z-score Low Resolution Electromagnetic Tomography Analysis (LORETA). It is a 19-electrode (cap system) that was introduced to the market by Applied Neurosciences, Inc. This system has the potential for faster results based on the larger number of electrodes (scalp sensors) applied to treatment [8]. Z-Score NFB uses a real-time comparison to an age-matched population of healthy subjects for data acquisition which simplifies protocol generation and allows clinicians to target modules and hubs that indicate dysregulation/instability in networks related to the patient's symptoms [9]. Z-score NFB increases specificity in operant conditioning-providing a guide that links extreme Z-score outliers to symptoms and then reinforcing Z-score shifts toward states of greater stability. The goal is increased efficiency of information processing in brain networks related to the patient's symptoms [10].

LORETA-based therapy also enables targeting a dysregulated electrical activity in the cerebral cortex much deeper than monitored by standard EEG-based NFB. In addition to that, it is relatively inexpensive computer software and EEG hardware makes this procedure potentially cost-effective. This technology has also been shown to be effective in therapy of many neuropsychiatric disorders including: chronic pain, depression, stroke rehabilitation as well as cognitive dysfunction [11-18].

Preliminary data from my center indicates successful primary and secondary generalized seizure response to this type of therapy. This editorial serves as an introduction to two upcoming articles that will report on the effectiveness of Z-score LORETA NFB for therapy of intractable epilepsy. One of these papers comes from my neurological practice and another one is authored by Dr. Lauren Frey et al. based on the data analysis from the academic university epilepsy clinic in the University of Colorado. Both of these centers use a similar approach for NFB programming, frequency of visits, and identical equipment. Dr. Frey uses as a potential target the default network, however my patient's therapy was based mostly on more variable and individualized protocols. Both centers have achieved major seizure reductions in most of the epilepsy patients--some of them reported a marked seizure reduction just after a few sessions. The accomplishment of similar positive results in two independent clinical sites (community setting and tertiary academic center) makes these findings even more encouraging. A larger (possibly placebo controlled) study may be beneficial in the future to further document efficiency of this type of NFB therapy in epilepsy patients.

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