Neurofeedback (NF) has been used effectively in the treatment of closed head injury, insomnia, migraine, depression, ADHD, and posttraumatic stress disorder. A recent meta-analysis review concluded epilepsy was positively impacted by clinical neurofeedback (p = 0.001). We therefore hypothesized that NF could serve as a therapeutic modality for epilepsy patients with refractory comorbidities. In the present study we applied a NF protocol to two male patients with well controlled seizures but with medically refractory comorbidities: insomnia, intractable headaches and ADHD in Patient A, and episodic dyscontrol (self-banging/ mutilating episodes) in Patient B.

**Rationale**

**Neurofeedback** is in essence EEG operant conditioning. The individual receiving neurofeedback is given a computerized program to watch, the content of which is mostly driven by real-time EEG behavior and examiner-selected EEG frequencies. Along these lines, the individual is cured with respect to the presence of excessive excursions in EEG amplitudes that may arise from paroxysmal activity and other physiologic non-epileptic factors (Figure 1.)

In neurofeedback the individual is "trained," "reinforced," or "exercised" to remain within specific parameter ranges with respect to frequency, net amplitude, or phase (which are selectively fed to control the video) that are assessed to reflect his or her optimal level of functioning. The resulting induced state shift may be subjectively felt somewhat immediately, and may last for days. Over the course of about 20 training sessions the individual's central nervous system (CNS) is likely to have "learned" enhanced control of state, and the capacity to maintain state regulation in the face of challenges leading to CNS stress.

**Methods**

We obtained consent for NF therapy promoting central nervous system (CNS) self-regulation. Baseline performance tests (symptom profiles, TOVA®, QEEGs, and observer evaluations) were to be repeated after 14 sessions to compare results to pre-treatment baseline. Procedures were performed under physician direction and supervision (one of the authors) Patient A's implanted vagal nerve stimulator (VNS) device was temporarily inactivated for all his NF sessions. Initial NF trials sought an optimal reinforcement frequency (ORF) for each patient reflecting his optimal antidepressant state, based on subjective reporting by the patient as well as observer ratings of behavioral alertness. The ORF was established using bipolar training at T3-T4 (the ORF being within the clinical EEG band, particularly the infra-low region < = 0.1 – 1.5 Hz). The T3-T4 bipolar recording was used to maximize the reward-based feedback frequency signal without violating hemispheric coherence (of concern in individuals with seizures). Subsequently, each patient was scheduled to receive 21 separate 30-minute NF sessions (Other protocol2) over a period of four weeks. The computer system used for clinical neurofeedback integrated with computerized neurofeedback software, integrated with Somatic Vision videogames, run via Windows XP (or Vista) operating system and standard PC desktops and high-resolution monitors.

**Results**

**Discussion**

It is likely that the mechanisms for epilepsy in both individuals were also favorably impacted, given that their comorbidities improved and because of supportive literature in this regard. Many epilepsy comorbidities are synchronized with the same CNS expressions of the same CNS dysregulation. The individual receiving neurofeedback is given a computerized program to watch, the content of which is mostly driven by real-time EEG behavior and examiner-selected EEG frequencies. Along these lines, the individual is cured with respect to the presence of excessive excursions in EEG amplitudes that may arise from paroxysmal activity and other physiologic non-epileptic factors (Figure 1.)

In neurofeedback the individual is "trained," "reinforced," or "exercised" to remain within specific parameter ranges with respect to frequency, net amplitude, or phase (which are selectively fed to control the video) that are assessed to reflect his or her optimal level of functioning. The resulting induced state shift may be subjectively felt somewhat immediately, and may last for days. Over the course of about 20 training sessions the individual's central nervous system (CNS) is likely to have "learned" enhanced control of state, and the capacity to maintain state regulation in the face of challenges leading to CNS stress.

**Conclusion**

Early results support the hypothesis that clinical neurofeedback is a useful therapeutic modality for managing epilepsy comorbidities without compromising seizure control. Furthermore, NF treatment can allow medications other than AEDs to be discontinued, thereby averting potential adverse effects arising from multiple drug interactions. The success of neurofeedback in this regard, fully understood and better understood, may lead to a more integrative understanding of the multi-level mechanisms underlying epilepsy and its comorbidities. Not least, because of reported adverse effects on the developing brain by excessively excursions in EEG amplitudes that may arise from paroxysmal activity and other physiologic non-epileptic factors (Figure 1.)

In neurofeedback the individual is "trained," "reinforced," or "exercised" to remain within specific parameter ranges with respect to frequency, net amplitude, or phase (which are selectively fed to control the video) that are assessed to reflect his or her optimal level of functioning. The resulting induced state shift may be subjectively felt somewhat immediately, and may last for days. Over the course of about 20 training sessions the individual's central nervous system (CNS) is likely to have "learned" enhanced control of state, and the capacity to maintain state regulation in the face of challenges leading to CNS stress.

**References**

2. Feinstein B et al. Sleep Research 1974;3:134

**List of Figure(s)**

Figure 1. Computerized neurofeedback software, integrated with Somatic Vision videogames, run via Windows XP (or Vista) operating system and standard PC desktops and high-resolution monitors.