Neurotherapy of Traumatic Brain Injury/Post-Traumatic Stress Symptoms in Vietnam Veterans

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ABSTRACT Previous report suggested the beneficial effects of an adaptation of the Flexyx Neurotherapy System (FNS) for the amelioration of mixed traumatic brain injury/post-traumatic stress symptoms in veterans of the Afghanistan and Iraq wars. As a novel variant of electroencephalograph biofeedback, FNS falls within the bioenergy domain of complementary and alternative medicine. Rather than learning voluntary control over the production/inhibition of brain wave patterns, FNS involves offsetting stimulation of brain wave activity by means of an external energy source, specifically, the conduction of electromagnetic energy stimulation via the connecting electroencephalograph cables. Essentially, these procedures subliminally induce strategic distortion of ongoing brain wave activity to presumably facilitate resetting of more adaptive patterns of activity. Reported herein are two cases of Vietnam veterans with mixed traumatic brain injury/post-traumatic stress symptoms, each treated with FNS for 25 sessions. Comparisons of pre- and post-treatment questionnaire assessments revealed notable decreases for all symptoms, suggesting improvements across the broad domains of cognition, pain, sleep, fatigue, and mood/emotion, including post-traumatic stress symptoms, as well as for overall activity levels. Findings suggest FNS treatment may be of potential benefit for the partial amelioration of symptoms, even in some individuals for whom symptoms have been present for decades.

INTRODUCTION

It is well known that many Vietnam War veterans continue to experience severe post-traumatic stress symptoms. The landmark National Vietnam Veterans Readjustment Study[1] of the psychological problems of Vietnam veterans postwar circa 20 years later identified 15.2% of male and 8.5% of female theater veterans manifesting full-blown post-traumatic stress disorder (PTSD), and an additional 11.1% of male and 7.8% female theater veterans with bothersome subthreshold symptoms. Data collection recently completed for a subsequent congressionally mandated follow-up study, the National Vietnam Veterans Longitudinal Study,[2] continues to find, 41 years after the war ended, high prevalence of persistent PTSD, estimated at 11.2% for combat veterans (or about 283,000 males and 400 females living today).

It is likely that many of these Vietnam veterans also suffered traumatic brain injuries (TBIs). In her review of the records from that period, Yost noted, "The frequency of severe [typically penetrating] head wounds during the Vietnam War was overwhelming,"[3(p159)] and "those with head injuries had less positive outcomes"[3(p159)] than those with limb damage, although advances in care at the time still led to improved survival rates. However, the scientific literature is nearly silent regarding the matter of closed head injuries. Indeed, "for those with minor head wounds ... care seemed to have devolved, often leaving them as an afterthought for treatment that was more appropriately managed by analytic psychiatry than neurology."[3(p163)] It is believed that due to lack of awareness of the "potentially long-lasting and debilitating effects of TBI,"[4(p450–1)] many veterans "fell through cracks in the system" of care.[4(p451)] Nonetheless, substantial numbers of these individuals, including those in the most recent National Vietnam Veterans Longitudinal Study, are likely to have persistent postconcussive sequelae, and sizeable numbers of these individuals may have coexisting PTSD symptoms.

It is increasingly recognized that PTSD (full-blown or subthreshold) and TBI may co-occur in the same individual.[5] Matters are further confounded by the overlap in symptoms characteristic of both TBI and PTSD, including cognitive problems, sleep disturbances, mood/emotional irregularities, and other difficulties.[6–8] PTSD itself is associated with a wide range of psychiatric comorbidity, poor quality of life, and social dysfunctions.[9–11] Disentangling the effects of TBI and PTSD or subthreshold post-traumatic stress features can be extremely challenging.[12,13] In addition, both distinct and shared mechanisms may interact in producing features associated with TBI and PTSD.[6–8,14]

Although various psychopharmacological and psychotherapeutic techniques are available to address the symptoms of PTSD and TBI, they are far from universally effective.[5] The limited options for effective treatment of TBI have been particularly lamented.[15] Accordingly, the nature of these syndromes poses significant rehabilitation challenges for large numbers of veterans to the present day. There remains a strong need to develop more effective treatments.

A previous report[16] involving veterans of the Afghanistan and Iraq wars suffering from mixed TBI/post-traumatic stress symptoms suggested the potential of an adaptation of the Flexyx Neurotherapy System (FNS) to alter brain wave functioning and thereby improve symptoms. As a novel variant of electroencephalograph (EEG) biofeedback, FNS falls within the bioenergy domain of complementary and alternative

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medicine. Typically, EEG biofeedback is performed within an operant conditioning framework wherein subjects acquire the skills to change patterns of EEG activity (i.e., they learn voluntary control over production/inhibition of brain wave patterns), which involves considerable time and effort.[17] FNS instead involves offsetting stimulation of brain wave activity by means of an external energy source, specifically, the conduction of electromagnetic energy (EM) stimulation via the connecting EEG cables.[18] FNS has been further adapted by the utilization of two-channel, versus one-channel only, neurofeedback. This article reports on findings obtained in FNS treatment to address whether the much longer duration (i.e., decades) of symptoms experienced by Vietnam veterans relative to Iraq/Afghanistan veterans is a barrier to response to this intervention.

METHODS

Two Vietnam Veterans with persistently bothersome PTSD symptoms and histories of TBI were referred for FNS treatment. The two veterans were both males in their early to mid-60s at the time of treatment. Veteran 1 (V1) had served in the Air Force and Veteran 2 (V2) as a Navy Seal. V1 had sustained TBIs in parachuting incidents during training and in Vietnam, with at least two episodes of loss of consciousness (one episode lasting at least 1 hour), as well as multiple incidents during 5 years of torture as a prisoner of war. Malnutrition as a prisoner of war also resulted in beriberi-related cardiac insufficiency and painful movement as well as lingering painful effects of broken bones from various incidents. He was classified as disabled at the time of referral. V2 was repeatedly dazed during training exercises, also sustained multiple parachuting incidents with TBI, and ruptured an eardrum while underwater because of an explosive shock wave. In addition, he suffered from the effects of military and subsequent civilian injuries in terms of vertebral compression, thoracic outlet syndrome, and atrial fibrillation. He was employed at the time of referral. Both evidenced an admixture of TBI sequelae and PTSD. Both had long stalled in experiencing any improvement in their conditions with medications and psychotherapy.

The two veterans completed pre- and post-treatment questionnaire assessments with the PTSD Symptom Scale (PSS),[19] which contains 17 items designed to diagnose PTSD according to Diagnostic and Statistical Manual of Mental Disorders criteria used in practice at the time. The items are also grouped according to three PTSD symptom clusters: re-experiencing (e.g., "having upsetting thoughts or images about the traumatic event that came into your head when you didn't want them to," "having bad dreams or nightmares about the traumatic event"), avoidance (e.g., "trying not to think about, talk about, or have feelings about the traumatic event"), and increased arousal (e.g., "being jumpy or easily startled"). A total severity and three subscale scores can be obtained. Also, at the beginning of each treatment session, subjective ratings of current levels of a standardized set of symptoms were made on separate 0 to 10 scales with appropriate anchors, including cognitive clouding (e.g., 0 = no cognitive clouding, 10 = worst cognitive clouding possible), overall body pain, quality of sleep, fatigue, anxiety, depression, irritability/anger, and overall activity. For all symptom rating scales, higher scores indicate greater subjective sense of difficulty. One veteran (V2) also completed ratings for individual symptoms identified at the outset as his most personally bothersome, including tinnitus, "foggy" feeling, procrastination, night sweats, hypervigilance, and trouble "going to bed."

FNS consists of a laptop computer and J&J Enterprises (Poulsbo, Washington) I-300 Compact 2 (C-2) Channel EEG module with on-board feedback generating power. It uses proprietary software to link the digital brain wave recording device (C-2 module) through the computer, which then sets the parameters for the C-2 module to emit pulsed EM stimulation.[18] The system returns a signal to the participant via conduction from the C-2 module, varying as a function of the detectable peak EEG frequency (but offset from it), thereby permitting strategic distortion of the EEG. The amount of EM stimulation was standardized with the feedback frequency being offset from the dominant EEG frequency at +20 Hz. Pulses of EM energy operated at a duty cycle of 1%, that is, of the maximum permissible on time for each pulse, they were powered no more than 1% of the time (e.g., the maximum on time at 1% for 1 Hz pulse was 0.01 second). Testing revealed a power level of 100 pico watts through the sensor cable (Weber Innovations, Ann Arbor, Michigan).

Participants attended approximately 2 to 3 sessions per week. They sat comfortably with eyes closed, and engaged in no specific activity. Electrodes were placed in a predetermined order over all areas of the cortex over the course of 25 sessions. Each session included 4 seconds of EM stimulation spaced over 4 minutes. The stimulation was not immediately discernible and adverse reactions (e.g., transient increases in typical symptoms following the first few sessions) were minimal. Participants were not asked to discuss past traumas as part of the process. Data analysis involved beginning to end of treatment comparisons of PSS scores and current subjective symptom ratings.

RESULTS

Beginning to end of treatment comparisons for PSS scores and current subjective symptom ratings are presented in Table I. Results reveal notable decreases for all comparisons for both veterans, suggesting improvements across the broad domains of cognition, pain, sleep, fatigue, mood/emotion, and overall activity level, at least as perceived by them. Although both reported significant decreases overall in post-traumatic symptoms on the PSS, V2 did not rate his level of avoidance behavior at the end of treatment much lower than he did at the outset. However, V2 also experienced very significant reductions across his most personally bothersome symptoms

TABLE I. Comparison of PTSD Symptom Scale (PSS) Scores and Current Symptom Ratings at Beginning and End of 25 Individual Treatment Sessions

	Veteran 1		Veteran 2	
	Begin	End	Begin	End
PSS				
Re-Experiencing	10	3	6	1
Avoidance	18	9	9	8
Arousal	15	8	8	5
Total	43	20	23	14
Current Symptom Ratings				
Cognitive Clouding	3.5	1.0	6.0	2.0
Pain	6.5	3.5	2.0	0.5
Quality of Sleep	6.5	3.0	7.0	2.0
Fatigue	5.5	3.0	5.5	2.0
Anxiety	6.0	0.5	4.0	3.0
Depression	6.5	0.5	3.0	1.0
Irritability/Anger	6.5	1.5	6.5	4.0
Overall Activity	6.5	3.5	6.5	2.5

Begin = Average of Session 1 and 2 ratings; End = Average of Session 24 and 25 ratings; Higher Current Symptom Rating scores indicate greater difficulty.

with average ratings down from 8.3 to 1.5 from beginning to end of treatment. According to veterans' self-report, medication usage remained stable or decreased during time in treatment, although prescription records were not available to verify.

DISCUSSION

Findings from these two veterans with mixed TBI/PTSD syndromes suggest FNS treatment may be of potential benefit for the partial amelioration of symptoms, even in veterans for whom symptoms have been present for decades, such as those who have served in Vietnam. This is apparent for the array of subjective symptoms experienced by individuals such as these two with mixed trauma syndromes, including difficulties with cognition, pain, fatigue, sleep, and mood/emotion, including the gamut of post-traumatic stress features, and in terms of overall activity levels. On the other hand, the physical and emotional status of these individuals manifested much more complicated presentations, in part as a result of the greater passing of time and aging. Further, it is apparent that minor levels of symptoms persisted, although these were generally in the rather mild range (e.g., 0.5–3.0 on the 0–10 numerical symptom rating scales).

The specific neurotherapy intervention received by these two veterans is rather distinct from more traditional EEG biofeedback procedures that utilize relatively labor-intensive and time-consuming operant or reward-based learning procedures to produce or inhibit specific brain wave frequencies or frequency ranges. In the FNS treatment paradigm, participants remain relatively passive and are not instructed to actively try to alter brain wave production based on feedback regarding their EEG activity. Rather, the system monitors their EEG activity and utilizes it to set the parameters (as specified at preset times in the software) for briefly stimulating it with minute EM pulses from the current momentary peak or dominant frequency.

The adaptation of FNS described here also is part of an evolving technology. A precursor known as EEG-Driven Stimulation used photic stimulation designed to distort EEG activity; this level of EM stimulation is much greater than that involved in FNS.[20] In addition, another low-intensity technology, the Low Energy Neurofeedback System,[21] has been developed. However, to our knowledge, none of these have been tested for the treatment of TBI within double-blind, placebo-controlled clinical trials, and none of these treatments or other promising neurofeedback protocols have been adopted in mainstream medicine[22]; although one open-label study with a wait-list control condition that utilized FNS with single-channel monitoring found partial alleviation of some TBI symptoms.[23] Our experience with TBI/PTSD has been only with the two-channel FNS described here, and our preliminary work (including extended follow-up) with Afghanistan/Iraq veterans has been particularly encouraging.[16,24] Accordingly, better controlled clinical trials are needed to establish more definitively the efficacy of this form of neurotherapy for the treatment of mixed TBI/PTSD symptoms in diverse veteran samples.[22] Randomized, double-blind, placebo-controlled clinical research is particularly important since there is always the possibility of placebo responding or results because of other nonspecific effects.[25]

In addition, it is important to keep in mind that the improvements experienced by these two Vietnam veterans were based on subjective symptom reports. There is a need for future research to also assess electrophysiological and other psychophysical measures and other functional brain activation patterns as potential objective markers of improvement.[26,27] This would further enable better determination of any underlying mechanisms of change that might be operative. For the time being, we can only speculate that neuroplastic changes may be initiated by FNS stimulation. For example, given the passive nature of FNS, it may be that changes in functional connectivity within or between resting state networks may be occurring with successful treatment.[28–30] However, these or other mechanistic explanations await future investigation. Indeed, only future research will determine if this initial optimism is warranted and enable exploration of mechanisms that may underlie improvement as well as the individual phenotypes most likely to respond.

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