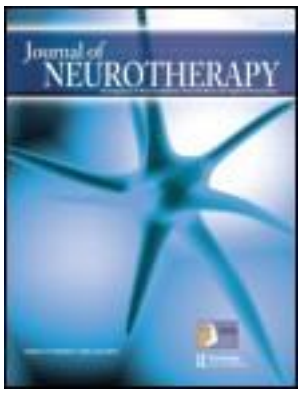

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Application of Neurofeedback in General Neurology Practice

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APPLICATION OF NEUROFEEDBACK IN GENERAL NEUROLOGY PRACTICE

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Neurofeedback (NFB), also called EEG biofeedback, is infrequently applied in general neurology practice. Therefore, this study was conducted to evaluate the clinical usefulness of NFB in neurological settings. Over the period of approximately 15 months, 25 subsequent patients who were interested in NFB therapy and completed at least 20 sessions of NFB treatment were analyzed for potential clinical benefits. Patients' subjective responses were collected after NFB treatment to see if any improvement of symptoms was accomplished with NFB therapy. Quantitative electroencephalography (QEEG) was completed before and after NFB therapy initiation and analyzed for any major changes in frequency bands expression. Patients' analysis revealed 84% subjective improvement rate and 75% objective QEEG improvement after completion of NFB therapy. These encouraging results indicate the need for more broad utilization of NFB in general neurology practice.

INTRODUCTION

Quantitative electroencephalography (QEEG) was introduced in 1970s initially as an experimental testing modality of brain-wave recordings. However, with time, it has become more widely used in neuroscience for neurological evaluation of epilepsy and behavioral problems in psychiatry (Aminoff, 1999; Michel, Koenig, Brandeis, Gianotti, & Wackerman, 2009).

Due to remarkable advancements in computer technology and the low cost of computers, QEEG testing became affordable for any medical practice. QEEG is based on mathematical processing of 20 to 30 min of standard EEG recording, which is able to condense the EEG data to a one-page color-coded summary. This gives a neurologist the unprecedented ability to look at summarized EEG information, which was not previously possible with regular EEG.

Neurofeedback (NFB) has been becoming gradually more popular as an alternative treatment modality since the 1960s, when the first experiments were conducted indicating its potential clinical value in the treatment of some neuropsychiatric disorders (Lubar & Lubar, 1984; Sterman & Egner, 2006).

Most NFB clinics are serviced by psychotherapists with only a few neurologists involved in NFB treatment. The U.S. neurological residency training does not formally include QEEG and NFB training; however, neurology training facilitates easier implementation of these techniques due to extensive neuroscience and EEG teaching.

In general neurological practice, there is a sizeable group of patients who do not respond to a conventional medical therapy. This justifies the search for other treatment modalities that could benefit patients who are resistant to conventional therapy.

Therefore, this study was conducted in order to evaluate the clinical usefulness of NFB in general neurological practice.

METHODS

This is a multicase report based on analysis of 25 patients who completed at least 20 sessions

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of NFB therapy in my general neurology clinic due to various neurological problems over the period of September 2010 to December 2011. Approximately 25 to 30% of patients did not complete their 20 sessions of NFB (dropouts) over the 15-month period. Simple statistical analysis using percentage has been applied to all patients. Patient workup was dependent on the presenting problem and frequently, in addition to general neurological examination included brain imaging (MRI or CT) and/or commercially available computerized neurocognitive testing (MindStreams assessment, NeuroTrax, Bellaire, TX). QEEG analysis was completed using commercially available Neuroguide software and previously recorded 19 channels digital EEG.

Approximately 1 to 3 min of artifact-free, eyes-closed EEG segments were selected and subjected to further QEEG analysis. The LORETA was also used in some patients for better cortical localization of the clinical problem (Pascual-Marqui, Michel, & Lehmann, 1994).

NFB was completed by two collaborating psychotherapists in my practice who have used conventional one electrode technique and commercially available equipment (EEG Spectrum and Cygnet). NFB was guided by QEEG findings (deviation from the norm) identified before therapy initiation in association with a patient's symptoms and focusing on correction of these deviations.

RESULTS

As seen in Table 1, the majority of the patients in this case series (21 of 25, 84%) reported at least mild improvement of the symptoms that concerned them after NFB therapy. Mild improvement was defined as subjective improvement as demonstrated by at least a 25%

TABLE 1. NFB Summary

Patient, age, gender	Symptoms	Subjective improvement	Objective QEEG improvement
1. 62 F	Cognitive/HA/Anxiety	improvement	(–) no improvement in theta, improvement in coherence
2. 18 M	Cognitive/ADD/AS	improvement	(–) no improvement in theta, beta
3. 43 F	Cognitive/HA/Anxiety	improvement	(+) improvement in beta
4. 76 M	Cognitive/CVA	much improved	(+) improvement in theta
5. 10 M	ADD	not sure	(–) no improvement in theta
6. 23 M	Autism/Seizure	much improved	(+) improvement in theta and delta
7. 42 M	Major TBI/HA	improved	(+) improvement in delta and theta
8. 28 M	Cognitive/Depression/Behavior	improved	(+) improvement in delta power and alpha asymmetry
9. 24 F	HA/Anxiety/Depression	improved	(+) mild improvement in beta power
10. 59 F	Cognitive/HA/Seizure	improved	(+) marked improvement in theta
11. 36 F	Cognitive/HA/Pain	improved	(+) improvement in theta but not in beta
12. 63 F	Fibro/Anxiety	improved	(+) improvement in theta and beta
13. 46 F	HA/ADD/Depression	improved	(+) improvement in alpha asymmetry
14. 85 M	Cognitive/Tremor	not sure	(–) no improvement in delta
15. 15 M	ADHD/Cognitive	not sure	(–) minimal if any in delta and beta power
16. 44 F	HA	improved	(+) mild improvement in beta power
17. 57 M	HA/Depression	not sure	(+) mild improvement in theta and beta
18. 25 F	HA	major improvement	(+) mild improvement in beta power
19. 63 F	HA	mild improvement	(+) mild improvement in frontal beta power
20. 29 F	HA	major improvement	(+) mild improvement in beta power
21. 30 M	Anxiety/Depression	improvement	(–) no major change
22. 38 F	HA/Fibromyalgia/Cognitive	mild if any	(+) mild improvement in coherence but not beta
23. 62 F	HA/Fibromyalgia	mild improvement	(+) mild improvement in beta power
24. 49 M	Cognitive/PTSD/Behavior	improvement	(+) mild improvement in theta and coherence
25. 74 M	Cognitive	mild improvement	not interested in F/U QEEG

Note. All patients who completed at least 20 sessions of neurofeedback are shown with major symptoms and subjective and quantitative electroencephalography (QEEG) outcome. F = female; HA = headache; M = male; ADD = attention deficit disorder; AS = Asperger's syndrome; CVA = cerebrovascular stroke; TBI = traumatic brain injury; ADHD = attention deficit hyperactivity disorder; PTSD = posttraumatic stress disorder; F/U = follow up. .

improvement of the symptoms. Eighteen of 24 (75%) patients were noted to have some improvement on QEEG after NFB treatment. ''Some improvement'' in QEEG is defined as minimal but noticeable (by visual inspection) correction of previously identified (pre-NFB) QEEG deviation from the norms in either particular band expression or coherence. One patient who was not interested in follow-up QEEG, however, reported mild improvement of symptoms after NFB completion. Three patients who completed NFB and reported improvement of their symptoms did not have objective change upon follow-up QEEG. One patient who reported no major improvement after NFB therapy was found to have mild improvement in QEEG findings.

DISCUSSION

This report contains an analysis of 25 consecutive patients from my neurology practice who underwent QEEG and completed at least 20 sessions of NFB therapy. To my knowledge this constitutes the first article to address usefulness of NFB in general neurological practice. Prior literature consists mostly of case studies or multiple case studies of selected neurological (Walker, 2011; Walker & Kozlowski, 2005) or psychiatric (Holtmann et al., 2011) conditions.

The 84% subjective improvement rate and 75% objective (QEEG) improvement rate indicates very good clinical outcome. Three patients who reported improvement in their symptoms and did not have any major change in QEEG may represent a placebo effect.

From a medical point of view, current underutilization of NFB by practicing neurologists likely impedes patients' clinical recovery, especially in those patients who are resistant to conventional medical treatment. QEEG analysis of patients with chronic headache (Table 1) is consistent with a prior report indicating an increase of beta power in frontal and/or occipital locations (Walker, 2011). These patients frequently suffer from coexisting anxiety contributing also to elevated beta band expression (Budzynski, Budzynski, Evans, & Abarbanel, 2009; Clark et al., 2009).

Pretreatment QEEG findings of patients with memory and cognitive problems (Table 1) revealed a marked increase of theta and sometimes even delta power, likely confirming an organic etiology of their underling condition. It seems to be that patients suffering from major dementia may show a global increase in theta or even delta power and patients having milder cognitive problems may have just fronto-temporal theta power elevation. These findings are in agreement with prior reports indicating the clinical usefulness of QEEG in the detection of demented individuals (Coburn et al., 2006; Deslandes et al., 2004; Koberda, 2011).

QEEG has been confirmed as clinically very useful in behavioral neurology testing (Koberda, 2011; Seagrave et al., 2011). QEEG findings of individuals diagnosed with ADHD and autistic spectrum disorder have been described in detail by other authors (Arns, Gunkelman, Marinus, & Desiree, 2008; Coben, Clarke, Hudspeth, & Barry, 2008; Di Michele, Prichep, John, & Chabot, 2005). NFB has also been found to be very effective in the treatment of epilepsy and recurrent migraine headaches (Sterman & Egner, 2006; Walker, 2011).

Based on the current findings, the addition of formal QEEG/NFB training during neurology residency is highly recommended in order to give young neurologists increased familiarity with these testing and treatment modalities.

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