QEEG-Guided Neurofeedback for Recurrent Migraine Headaches

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Key Words
Migraine Headache
Neurofeedback
Quantitative EEG

ABSTRACT

Seventy-one patients with recurrent migraine headaches, aged 17-62, from one neurological practice, completed a quantitative electroencephalogram (QEEG) procedure. All QEEG results indicated an excess of high-frequency beta activity (21-30 Hz) in 1-4 cortical areas. Forty-six of the 71 patients selected neurofeedback training while the remaining 25 chose to continue on drug therapy. Neurofeedback protocols consisted of reducing 21-30 Hz activity and increasing 10 Hz activity (5 sessions for each affected site). All the patients were classified as migraine without aura.

For the neurofeedback group the majority (54%) experienced complete cessation of their migraines, and many others (39%) experienced a reduction in migraine frequency of greater than 50%. Four percent experienced a decrease in headache frequency of <50%. Only one patient did not experience a reduction in headache frequency.

The control group of subjects who chose to continue drug therapy as opposed to neurofeedback experienced no change in headache frequency (68%), a reduction of less than 50% (20%), or a reduction greater than 50% (8%).

QEEG-guided neurofeedback appears to be dramatically effective in abolishing or significantly reducing headache frequency in patients with recurrent migraine.

INTRODUCTION

Migraine is common, occurring in 28 million Americans, including 18% of women and 6% of men.[1,2] Migraine commonly produces absenteeism and decreased productivity and reduces the quality of life.[3] Only 29% of migraine sufferers are very satisfied with their usual acute treatment, and only 48% are somewhat satisfied. Eighty-seven percent believe that treatment takes too long to achieve pain relief, and 84% report that it does not relieve all of their pain, and that it does not always work. Seventy-one percent noted that headaches returned after treatment.[4] More than one-third reported that treatment was associated with too many side effects. Neuroimaging studies such as MRI are usually normal in uncomplicated migraine.[5] In this paper I report on Quantitative EEG (QEEG), an alternative imaging technique, which is usually abnormal in patients with recurrent migraine. In our experience when neurofeedback is used to normalize the QEEG the majority of patients become drug-free and no longer have headaches. Almost all other patients report a decrease in migraine frequency and severity.

Previous studies of QEEG in migraine

Routine EEG, done between episodes of headache, has not proven to be useful in the evaluation of patients with headaches.[6] QEEG abnormalities have been reported in a few studies.[7] Fachetti[8] found increased focal slowing (vs. controls) in 65% of 31 patients. Lia et al.[9] found abnormal relative power spectral values in 39% of 28 migraine patients, mainly increased slow activity or decreased alpha activity in the posterior leads. Neufeld et al.[10] found lower alpha power compared with healthy controls. Bjork et al.[11] found increased relative theta power in all cortical regions and increased delta power in the frontocentral region during migraines. The databases used in past studies did not evaluate high frequency beta activity (21-30 Hz) separately. In the current study we found that this spectrum of activity was the one involved in our patients. Clemens et al.[12] used LORETA to evaluate migraine patients in the pain-free interval. They found increased power in 19 cortical areas in delta (1.5-3.5 Hz), theta (4.0-7.5 Hz) and beta (13-25Hz) bands. The only statistically significant finding was an increase in right occipital alpha power. They did not separate out 21-25 Hz activity nor did they measure power in the 26-30 Hz range. The LORETA findings were of increased alpha activity in the precuneus and the right posterior temporal gyrus, along with decreased alpha activity in medial frontal cortex bilaterally, including the anterior cingulate gyrus and the superior and medial frontal gyri.

Previous studies of neurofeedback for migraine (not QEEG-guided)

The first report of successful remediation of migraine headaches was by the Othmers.[13] They usually down-trained 2-7 Hz and high-frequency beta and up-trained 15-18 Hz at C3 for left-sided headaches. For right-sided headaches, they usually down-trained 2-7 Hz and high frequency beta and up-trained 12-15 Hz. More recently, they have used bipolar training at T3 and T4, tailoring the reward to the patients' headache relief.[14] Stokes and Lappin[15] combined bipolar interhemispheric neurofeedback, thermal biofeedback, and blood flow feedback (hemoencephalography) and found that headache frequency decreased by 70% or more and pain severity by 50% or more in the majority of her patients. Siniatchkin and colleagues[16] fed back slow cortical potentials in children with migraine and found the technique clinically efficacious. Tansy[17] trained four migraineurs to increase beta (12-15 Hz) and decrease theta (4-7 Hz) at CZ and was able to eliminate their migraines.

MATERIALS AND METHODS

Seventy-one patients, aged 17 to 62 presented to the Neurotherapy Center of Dallas with the chief complaint of recurrent migraine headaches. All patients completed a Quantitative EEG, using the Thatcher Neuroguide database to assess the power of delta (1-3 Hz), theta (4-7 Hz), alpha (8-12 Hz), beta (13-20 Hz), and high frequency beta (21-30 Hz) when compared to normal individuals. Forty-six patients elected to do neurofeedback based on their QEEG abnormalities to remediate their migraine headaches. Twenty-five elected not to do neurofeedback and continued anti-migraine drug

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Table 1

Frequency of Significant Focal Abnormalities in Migraine Patients (in rank order)

Abnormality	Frequency (% of patients with abnormality)
Excess Absolute 21-30 Hz Cz	62
Excess Absolute 21-30 Hz P3	58
Excess Absolute 21-30 Hz Pz	55
Excess Relative 21-30 Hz Cz	50
Excess Absolute 21-30 Hz P4	48
Excess Relative 21-30 Hz FP2	46
Excess Absolute 21-30 Hz C4	45
Excess Relative 21-30 Hz P3	45
Excess Relative 21-30 Hz P3	45
Excess Absolute 21-30 Hz C3	45
Excess Relative 21-30 Hz C3	43
Excess Relative 21-30 Hz Pz	43
Excess Relative 21-30 Hz FP1	43
Excess Relative 21-30 Hz F7	43

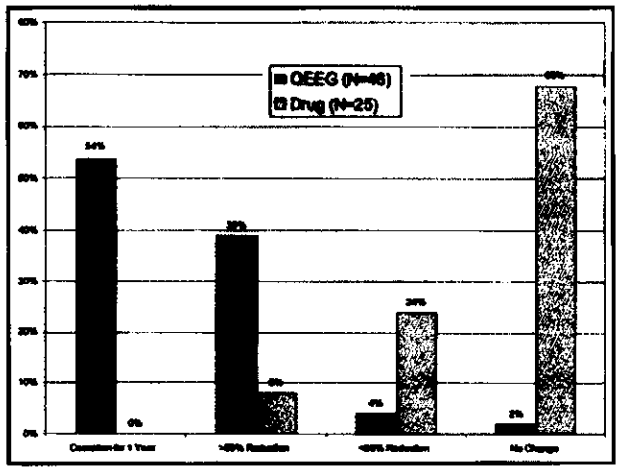

Figure 1.
Effect of neurofeedback vs. drug therapy on migraine headache frequency.

therapy. All patients were followed for at least one year. Neurofeedback training was accomplished using a Brainmaster® 2-channel unit. The number of neurofeedback sessions ranged from 12-32 (average 24). In each session 10 Hz activity was rewarded, along with reward for reducing 21-30 Hz. Five sessions were done for each area where high frequency beta was abnormally increased. The patients kept a diary and recorded each headache occurrence. The frequency was calculated in headaches per month.

RESULTS

QEEG results

The only significant abnormalities were excesses in the high frequency beta band (21-30 Hz) (Table 1). The most significant abnormalities were found in the parietal, central, and frontal regions.

Results of neurofeedback training

Each patient received five 30-minute sessions of neurofeedback to decrease 21-30 Hz at each site where it was elevated. Figure 1 indicates the questionnaire results of QEEG-guided neurofeedback in this group. In comparison, those patients who did not choose to do neurofeedback, all continued to have frequent migraine headaches (at least one per month).

DISCUSSION

Migraine patients had abnormal QEEGs characterized by excessive high frequency beta activity (21-30 Hz) in 1-4 areas of the brain, most commonly in parietal, central, or frontal areas.

When neurofeedback training was done to reduce high frequency beta and increase 10 Hz at those sites, the majority of the patients experienced complete remission of migraines (54%). Most of the other patients experienced a significant reduction in migraine frequency (50% or greater in 39% and less than 50% in 4%). Only one patient did not experience a reduction in migraine frequency. In contrast, patients who chose to remain on drug therapy experienced no change in frequency most of the time (68%). Eight per cent did experience a decrease in frequency of 50% or more. Two per cent noticed a decrease of less than 50%.

CONCLUSIONS

QEEG-guided neurofeedback appears to be dramatically effective in abolishing or significantly reducing migraine frequency in the great majority of patients with recurrent migraine headache.

Drug therapy of any kind rarely eliminates migraine headaches. Peripheral biofeedback (e.g., temperature training) may decrease the frequency of migraines, but rarely eliminates them.[18] Symptom-based neurofeedback (e.g., C4SMR uptraining) training may eliminate migraines, but it does so less frequently than QEEG-guided training, in our clinical experience. A controlled trial should be done to compare these two approaches.

DISCLOSURE AND CONFLICT OF INTEREST

J.E. Walker has no conflicts of interest in relation to this article.

REFERENCES

1. The International Classification of Headache Disorders, 2nd ed. Cephalagia 2004; 24 (suppl 1): 1-160.
2. Stewart WF, Lipton RB, Celentaus DD, Reed ML. Prevalence of migraine headache in the United States: relation to age, income, race, and other sociodemographic factors. JAMA 1992; 267: 64-69.
3. Dahlof CG, Solomon GD. The burden of migraine to the individual sufferer: a review. Eur J Neurology 1998; 5: 525-533.
4. Lipton RB, Stewart WF. Acute migraine therapy: do doctors understand what patients with migraine want from therapy? Headache 1999; 39 (suppl 5): 250-256.
5. Frishberg B, Rosenberg J, Matchhar D. Evidence-based guidelines in the primary care setting: neuroimaging studies in patients with acute headache. Available at http://www.aan.org.
6. Rosenberg J, Alter M, Byrne TD, Daube JR, Franklin G, Goldstein MC, et al. Practice parameter: the electroencephalogram in the evaluation of headache. Report of the quality standards subcommittee of the American Academy of Neurology 1995: 45: 1411-1413.
7. Sand T. Electroencephalography in migraine: a review with focus on quantitative electroencephalography and the migraine vs.epilelpsy relationship. Cephalgia 2003; 23 (suppl 1): 5-11.
8. Fachetti D, Marsile C, Faggi L, Donati E, Kokodoko A, Poloni M. Cerebral mapping in subjects suffering from migraine with aura. Cephalgia 1990; 10: 279-284.
9. Lia C, Carenini C, Degioz C, Bottachi E. Computerized EEG analysis in migraine patients. Italian J Neurol Sci 1995; 16: 249-254.
10. Neufeld MV, Treves TA, Kovczyn AD. EEG and topographic frequency analysis in common and classic migraine. Headache 1991; 31: 232-236.
11. Bjork M H, Stovner LJ, Engstrom M, Stjern J, Hagen K, Sand T. Interictal quantitative EEG in migraine: a blinded, controlled study. J Headache and Pain 2009; 10: 1129-1136.
12. Clemens B, Baniok J, Piros P, Bessengei M, Veto S, Toth M, Kondaker I. Three-dimensional localization of abnormal EEG activity in migraine: a low resolution electromagnetic topography (LORETA) study of migraine patients in the pain-free interval. Brain Topogr 2008; 21: 36-42.
13. Othmer SO. EEG biofeedback training. Megabrain Report. J Mind Technology 1994; 2: 43-47.
14. Othmer S, Othmer S. Interhemispheric EEG training: clinical experience and conceptual models. In: Evans J. (ed). Handbook of Neurofeedback. New York: Haworth; 2001: 118.
15. Stokes D, Lappin M. EEG biofeedback, neuroencephalography feedback, and thermal biofeedback with 37 migraineurs. EEG Spectrum Clinical Interchange Conference. Los Angeles CA; April 25, 2008.
16. Siniatchkin M, Hierundar A, Knopp P, Gerber WD, Stefani U. Self –regulation of slow cortical potentials in children with migraine: an exploratory study. Applied Psychophysiology Biofeedback 2000; 25: 13-32.
17. Tansy MA. A neurobiological treatment for migraine: the response of four cases of migraine to EEG biofeedback training. Headache Quarterly: Current Treatment and Research 1991; 90-96.
18. Nestoriv Y, Martin A. Efficacy of biofeedback for migraine: a meta-analysis. Pain 2007: 128: 111-127.