Efficacy of neurofeedback for executive and memory function in dementia

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Abstract

Background

Previous studies have shown that dementia is associated with quantitative EEG (QEEG) abnormalities including increased slow activity and a reduction in the dominant alpha frequency.

Objective

This study tested whether using EEG biofeedback (neurofeedback) training to normalize abnormal EEG activity could improve measures of memory and executive function.

Methods

Participants were randomly assigned to immediate treatment or a waiting-list control group. All participants received neuropsychological and QEEG assessments before and after treatment or control conditions. Each participant's pre-treatment QEEG was compared to a normative database, and neurofeedback protocols were customized to normalize EEG activity at significantly deviant (10±22 delta) frequencies and specific scalp locations. Treatment consisted of 30 to 40, 30-minute neurofeedback training sessions involving operant conditioning of the EEG using simultaneous visual, auditory, and tactile reinforcements. To date, 18 subjects and 11 waitlist controls have completed treatment.

Results

Pre- and posttreatment scores displayed significant improvements in verbal memory (mean Mini-Mental Status Exam [MMSE] orientation and recall), Memory Assessment Scales (MAS) list and prose memory, p<.05; visual memory (mean MAS Visual and Rey Figure recall, p<.05); Behavioral Rating Inventory of Executive Function (mean self and informant) General Executive Composite, p<.05; Immediate Visual and Auditory (IVA) continuous performance test response control, p<.05. Trends toward improvement were seen in the WMSE [p=.072] and psychiatric distress measured by the Symptom Checklist 90-Revised (p=.072) and psychiatric distress measured by the Symptom Checklist 90-Revised (p=.072). In the control group, this correlation was -.06.

Conclusion

This study showed that neurofeedback training resulted in significant improvement in memory and some aspects of executive function, compared to a waiting list control, suggesting that neurofeedback is a possible efficacious treatment for dementia. The finding that the efficacy of neurofeedback is greater in persons with more intact memory function suggests that this intervention is more applicable for persons with earlier stage dementia. It also suggests that learning and memory are involved in neurofeedback's mechanism of action.

Discussion

The low subject number in this study made many significant findings borderline and many promising trends undetectable. The low subject number in this study made many significant findings borderline and many promising trends undetectable.

Appendix A

Table 1. Comparisons of pre- and posttreatment effect (standard score differences) vs controls.

Table 2. Table 1. Labeled t-test comparisons of pre- and posttreatment effect (standard score differences) vs controls.

Figure 1. Changes in executive function in treated participants vs controls.

Figure 2. Changes in visual memory in treated participants vs controls.

Figure 3. Changes in verbal memory in treated participants vs controls.

Figure 4. Compared to controls, treated participants showed greater changes in EEG amplitude above 10 Hz in the eyes-closed baselines (red circles denote positive p<.05).

Figure 5. Compared to controls, improvement in treated subjects showed a significantly greater correlation with reduction in slow wave activity.

Figure 6. Composite post-treatment QEEG differences of 5 most and least improved subjects.