Efficacy of EEG Biofeedback in Addressing Cognitive Dysfunction in Cancer Survivors

Jean Alvarez, David L. Granoff, Allan Lundy

Abstract

Purpose: This study examined the efficacy of EEG biofeedback (neurofeedback) in addressing the cognitive sequelae of cancer therapy, commonly known as "chemobrain" or "chemofog." Approximately fifty percent of breast cancer survivors exhibit cognitive impairment within three weeks of beginning chemotherapy, and half of those have not recovered one year later. Neurofeedback, unlike compensatory strategies currently recommended by the National Cancer Institute and major cancer centers, has the potential to restore cognitive function.

Methods: Participants were 23 female breast cancer survivors, at least 40 years old and 6 months to 5 years post-chemotherapy, who had self-reported distressing cognitive symptoms. They received two 33-minute neurofeedback training sessions each week for ten weeks. Neurofeedback was delivered via Zengar NeurOptimal Professional equipment, a systemic approach that provides concurrent feedback on EEG activity in 16 standard time-frequency envelopes. Four self-reported outcome measures, the FACT-Cog (with subscales of Perceived Impairment, Impact on QOL, Comments from Others and Perceived Abilities), FACIT-Fatigue, Pittsburgh Sleep Quality Index (PSQI; with 8 subscales), and Brief Symptom Inventory 18 (BSI 18; 4 dimensions), were used to assess cognitive impairment, fatigue, sleep disturbance, and psychological distress. Participants were tested three times at regular intervals over a ten-week period prior to the beginning of neurofeedback, and then three more times during the neurofeedback regimen. A final testing took place four weeks post-neurofeedback.

Results: As hypothesized, repeated-measures analysis of variance revealed significant improvements on all 17 measures, most at $p<.001$, which were linear over the course of neurofeedback training. Improvement was particularly strong in cognitive functioning, fatigue, and psychological symptoms of somatization and depression. On four of the measures (Perceived Impairment, Impact on QOL, Use of Sleep Medications, and Depression), it was observed that there had been significant improvement ($p<.05$) over the three pretests, presumably due to participants' optimism that neurofeedback would

relieve their symptoms, but even after subsequent improvements were adjusted for this effect, results remained significant ($p<.001$), with the exception of Use of Sleep Medications, which was no longer significant. Improvements were generally maintained at the follow-up testing, with only slight and non-significant improvements or declines shown on some measures. Other variables such as reported depression, age of participant, months since chemotherapy, etc. were unrelated to degree of improvement.

Conclusion: Data from this pilot study support the hypothesis that EEG biofeedback has potential for reversing or reducing the cognitive sequelae of cancer treatment. Larger-scale studies with placebo groups are needed to confirm this result and to explore whether EEG biofeedback, administered concurrently with cancer treatment, might reduce the incidence or severity of cognitive impairment.