

Quantification of Alertness, Memory and Neurophysiological Changes in Sleep Apnea Patients Following Treatment with nCPAP

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Introduction

Sleep Apnea (SA) patients treated with nCPAP during a 3-month study were repeatedly evaluated with an alertness and memory profile (AMP) with simultaneous acquisition of neurophysiological data. Each AMP session included a 3-Choice Psychomotor Vigilance Test, Verbal/Image Paired Associate Learning/Memory tests and a Sternberg Memory-Scan.

Methods

Forty-three patients (28 males; 15 females; mean age=49.7, range 31-71) diagnosed with SA (mean RDI=43.7, range 9-112) were evaluated during up to five AMP sessions. Sample sizes at time-points following pre-treatment were variable, because the study is not yet complete. Scheduled evaluations were conducted at 2-weeks (n=28), 1-month (n=26), 2-months (n=13) and 3-months (n=7) post-treatment with nCPAP. SA patients were compared to 47 healthy subjects (males=23; females=24; mean age=41.1, range 25-70) evaluated at the same five time-points. Continuous EEG (bipolar FzPOz and CzPOz, 256 samples/second, bandpass 0.5 Hz and 65Hz) was acquired during the AMP using a wireless sensor headset and automated B-Alert™ software to quantify the level of alertness during the session. Vigilance accuracy (VigAcc), vigilance reaction times (RT), number of lapses, accuracy across all memory tests (MemAcc) and percentage of EEG classified as drowsy were computed for each subject. These variables were z-score transformed relative to the healthy subjects.

Results

SA patients evaluated pre-treatment evidenced significantly lower VigAcc ($t=2.97$, $p<0.005$) with more lapses ($t=-3.71$, $p<0.001$), slower RT ($t=-3.35$, $p<0.001$), decreased MemAcc ($t=5.18$, $p<0.001$) and increased EEG classified as drowsy ($t=-2.30$, $p<0.05$) when compared to the healthy group during session one.

To assess the effects of nCPAP, patient data were z-scored to the healthy population. After 2-weeks of treatment, one-third of the SA patients evidenced improved performance, however, only MemAcc achieved significance ($t=-2.51$, $p<0.05$). After 1-month, VigAcc ($t=-2.17$, $p<0.05$) and MemAcc ($t=-2.79$, $p<0.01$) increased. After 2-months, significant decreases in RT ($t=3.18$, $p<0.01$) and percent EEG drowsy ($t=2.18$, $p<0.05$) were also observed. Although the sample size at 3-months was insufficient for statistical comparison, mean values suggested that patients continued to show improved memory and vigilance performance with decreased drowsy EEG. Using z-score thresholds that classified 95% of the healthy subjects as normal, the percentage of SA patients outside the normal range for VigAcc, lapses, and MemAcc decreased from 42-49% at baseline to 21-25% after one month of nCPAP.

Conclusions

Substantial data support the association between neurocognitive dysfunction and SA. Evidence-based outcome studies documenting improved cognition following nCPAP treatment are more limited. AMP provided rapid, repeatable quantification of the daytime symptoms of SA using neurophysiological and performance measures during vigilance, learning and memory tasks. Although a sub-group of SA patients evidenced improvements in alertness and memory after 2-weeks of treatment, some patients did not improve until after one- or two-months of treatment. Variability in the timecourse of nCPAP in ameliorating the neurocognitive deficits was most frequently associated with the time required for individual patients to adapt to nCPAP. Interestingly, patients continued to evidence improvements in alertness and memory at the 2-month and 3-month sessions, suggesting the potential value of more longitudinal studies with testing at 6- and 12-month intervals.

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