Appl Psychophysiol Biofeedback (2009) 34:319–321
DOI 10.1007/s10484-009-9104-3

Use of a Portable Biofeedback Device to Improve Insomnia in a Combat Zone, a Case Report

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Published online: 5 August 2009

Abstract Insomnia is a common problem in situations of stress. Some forms of stress, however, may contraindicate the use of traditional, pharmacological interventions. Working in a combat zone is such a situation. Alternative means of improving sleep are clearly needed for Service Members. We report a case involving a medical provider who was serving in a military, emergency-services facility in Iraq, and who presented with anxiety, depressed mood, and insomnia. Symptoms were sub-threshold for major depressive disorder or acute stress disorder. Mood and anxiety symptoms responded to traditional therapy techniques, but problems with insomnia remained. The patient was given a portable biofeedback device that employs an infrared sensor photoplethysmograph to measure heart rate variability (HRV) from peripheral finger pulse. One week later, sleep was significantly improved. Symptom improvement lasted to at least 6 weeks while in theater. One year later, a check-in with the patient revealed that after returning home, he had been diagnosed with post traumatic stress disorder (PTSD). PTSD symptoms had resolved after 6 months of psychopharmacology and cognitive behavioral therapy. These results indicate that biofeedback may be a useful means of improving sleep in a combat zone, but that such improvements may not necessarily prevent the development of more serious symptoms later. No clear causality can be inferred from a single case, and further study is needed to determine if this finding have wider applicability.

Keywords Anxiety · Combat disorders · Depression · Post traumatic stress disorder · Sleep · War

Introduction

Sleep problems are common and can significantly impact daily functioning and overall wellbeing (Kahneman et al. 2006). There is no shortage of treatments for insomnia. Both medications (Ramakrishnan and Scheid 2007) and cognitive behavioral (Jacobs et al. 2004) interventions have been shown to be effective. Unfortunately, there are situations in which neither option is practical. One of the most dramatic examples is the case of Service Members deployed to combat zones. Service Members may need to be awakened at a moment's notice, contraindicating medications that cause residual sedation. Also, behavioral techniques that require sleep hygiene (a consistent sleep schedule, peaceful sleeping environment, and prohibit compensatory daytime naps) are simply not feasible. One potential solution to this situation may be portable biofeedback devices that calm the mind and relax the body.

Biofeedback has a very long history for treating insomnia (Hauri 1981). Although there are methods with more established evidence, Biofeedback for insomnia meets American Psychological Association criteria for probably

The opinions expressed in this article are those of the author, and do not necessarily reflect the opinions of Naval Medical Center San Diego, The United States Navy, or the Department of Defense.

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efficacious treatments (Morin et al. 1999). Portable home biofeedback devices have recently become commercially available, and have been found to have benefit for insomnia (Ebben et al. 2009). Faced with a situation in which few other treatments seemed viable, the senior author (R.N.M) offered a Service Member with intractable insomnia such an option.

Case

The patient was a 39-year-old male, who was serving as a medical provider in an emergency services facility in Iraq. His duties required him to be on-call around the clock during a 6-month deployment. He reported a history of insomnia going back to his teenage years, with problems both with sleep onset and sleep maintenance. There was no evidence of airway difficulty or neurological impairment. He did not meet criteria for Major Depressive Disorder, Acute Stress Disorder, or any other significant psychiatric disorder beyond Adjustment Disorder. This was determined by clinical interview, and by using diagnostic and statistical manual criteria. No validated measures of anxiety or depression were used at that time. The patient did experience some problem areas, including interpersonal conflicts and some acute stress symptoms related to being under fire while on missions. The patient was seen for cognitive behavioral therapy by the senior author (R.N.M) with the goal of reducing anxiety and improving mood and sleep. This therapy included education on sleep hygiene, and education in sleep restriction and stimulus control. After six sessions of therapy over 8 weeks, anxiety, depression and self esteem were improved. He was laughing and smiling in sessions and no longer complained of any problems with depression or anxiety. Insomnia, however, remained a problem.

At this point in treatment, several standardized instruments were administered to try and quantify the severity of sleep impairment. Pittsburgh Sleep Quality Index (PSQI) (Buysse et al. 1989) score was 10. The PSQI measures sleep quality over a 4 week period. A global PSQI score greater than 5 has a sensitivity of 89.6% and specificity of 86.5% for distinguishing good and poor sleepers (Buysse et al. 1989). Score on the Groningen Sleep Quality Scale (GSQS) was 9. This test is similar to the PSQI, but measures sleep quality over a single night (Mulder-Hajonides van der Meulen et al. 1980). Maximum score is 14, with higher numbers (above 6 or 7) indicating a poor night's sleep. Score on the Epworth Sleepiness Scale (ESS) was 8. The ESS is a measure of daytime fatigue, with a score above 7 indicating significant fatigue (Johns 1991).

On the day these tests were administered, the patient was given a StressEraser unit and accompanying instructional materials. He was asked to try the device for sleep. The StressEraser is a handheld biofeedback device that is sold commercially as a Food and Drug Administration Class II, 510(k) exempt, handheld medical device. Its use has been described in detail previously (Heilman et al. 2008). It employs an infrared sensor photoplethysmograph to measure heart rate variability (HRV) from peripheral finger pulse. HRV is associated with decreased sleep fragmentation (Sforza et al. 2007) Written materials instruct the user in slowed abdominal breathing (Yildiz and Ider 2006) and attentional retraining (learning to comfortably focus in the moment and away from stressful thoughts). The device displays heart rate as a wave, which normally increases with inspiration and decreases with expiration. With sympathetic stress, HRV is restricted, whereas with parasympathetic recuperation, HRV increases. Success in improving HRV reinforced in the form of points, which are continuously tallied and displayed on the screen. Instructions were to use the device before bedtime until sleepy, or until one hundred points were achieved.

The patient was seen for follow-up 1 week later. He reported that he had been practicing with the device, and found that his sleep was much improved. GSQI was decreased to 3, and ESS was 2. A modified version of the PSQI was also administered at this point, with the patient asked to consider only the last week rather than the traditional 4 week period. Score on this modified PQSI was 0. The patient was asked to continue with the device, and individual therapy continued with focus on interpersonal issues rather than sleep. Six weeks later, sleep improvements were still maintained. PSQI score was 3. GSQI score was 0, and ESS score was 0. Overall, the patient reported that he was no longer having difficulties with sleep. Treatment was terminated, and the patient returned to his regular duties.

The patient was interviewed by phone 1 year after initial treatment. He reported that, 2 months after his last session, he had returned home from his deployment. He had done well initially, but then started having worsening problems with anxiety, depression, and post-traumatic stress. Three months after returning home, he had seen a psychologist and been diagnosed with post traumatic stress disorder (PTSD). He was started on a selective serotonin reuptake inhibitor (SSRI), and had been seen for 7 months of psychotherapy. With this treatment, his symptoms had again remitted. He was not formally re-assessed for insomnia at this point, but reported that he was sleeping well.

Discussion

This case illustrates both the utility and the limitations of using biofeedback to improve sleep for Service Members. The patient's sleep did improve dramatically with the use

of biofeedback. Causality can not be inferred from a single case, but the fact that this patient had already been in therapy for 8 weeks prior to the use of the biofeedback device does suggest that something other than placebo effect or courtesy bias was at work. Further study is needed to determine how widely applicable such a treatment method would be, and how much of the result is actually due to the biofeedback rather than to placebo effect. If the effect on sleep is reproducible, home biofeedback devices may be useful in situations in which sleep medications and/or intensive therapies aimed at sleep are not practical.

Although sleep improved in the field for this patient, the improvement did not prevent more serious symptoms from developing later. PTSD is a notoriously difficult condition to prevent (Roberts et al. 2009). Biofeedback alone has not been particularly effective in treating PTSD (Watson et al. 1997). Although the temporary remission of symptoms during deployment appears to have been facilitated by use of this personal biofeedback device, it was unsuccessful in preventing the onset of post-deployment PTSD. The use of a personal biofeedback device is certainly not intended to be a replacement for comprehensive therapy. The patient did eventually respond to an intensive course of psychotherapy and psychopharmacology, and the end result was positive for this patient. Of course, it is unclear what if any role the biofeedback, or other aspects of early intervention, played in delaying onset of PTSD or allowing this eventual recovery. PTSD and insomnia may both follow a waxing and waning course over the lifetime (Solomon et al. 1994). More research is needed to determine if early biofeedback or other interventions for sleep may improve eventual outcomes in PTSD.

More work also is needed to determine what types of biofeedback might be best suited to treat insomnia. The StressEraser was chosen simply because of the availability of the device and its ability to be used in a field setting, rather than a belief that HRV is the ideal way of doing biofeedback for sleep. HRV has been suggested to play an important roll in PTSD (Mellman et al. 2004), yet many biofeedback modalities have been suggested to improve insomnia (Hauri 1981; Morin et al. 1999. It will be important to determine if different modalities have different effects. Still, this case report demonstrates that the StressEraser is field deployable, can be utilized during the onset of initial symptoms, and should not be considered a substitute for a more comprehensive treatment program for insomnia, especially when that insomnia is likely secondary to a primary cause.

Conflict of interest statement The authors have no financial support or conflict of interest to disclose.

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