Ultra-Slow delta power in chronic fatigue syndrome

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ABSTRACT

The role of sleep in patients diagnosed with chronic fatigue syndrome is not fully understood. Studies of polysomnographic and quantitative sleep electroencephalographic (EEG) measures have provided contradictory results, with few consistent findings in patients with Chronic Fatigue Syndrome (CFS).

For the most part, it appears that delta EEG activity may provide the best discrimination between patients and healthy controls. A closer examination of delta activity in the very slow end of the frequency band is still to be considered in assessing sleep in CFS. The present preliminary study compared absolute and relative spectral power in conventional EEG bands and ultra-slow delta (0.5–0.8 Hz) between 10 young female patients with the CFS and healthy controls without psychopathology. In absolute measures, the ultra-slow delta power was lower in CFS, about one-fifth that of the control group. Other frequency bands did not differ between groups. Relative ultra-slow delta power was lower in patients than in controls. CFS is associated with lower ultra-slow (0.5–0.8 Hz) delta power, underscoring the importance of looking beyond conventional EEG frequency bands. From a neurophysiological standpoint, lower ultra-slow wave power may indicate abnormalities in the oscillations in membrane potential or a failure in neural recruitment in those with CFS.

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1. Introduction

Although Chronic Fatigue Syndrome (CFS) is recognized by the Center for Disease Control (CDC) criteria, the existence of this condition is still debated. The points of view are so divergent that CFS has been considered the expression of somatic complaints accompanying psychiatric syndromes, or, by contrast, the result of a viral infection, hormonal dysregulation, auto-immune disease or the consequences of poor sleep, whether specific or not.

The 1994 CDC criteria (Fukuda et al., 1994) are the most frequently used for research purposes, as this definition is neutral in term of etiology or pathophysiology. However, as the syndrome is mainly defined by its core symptom of fatigue, it may include different conditions under the same name. Primary sleep disorders, generally associated with sleepiness, for instance, have been estimated somewhere between 0% (Reeves et al., 2006) and 62.5% (Krupp et al., 1993). Major Depression Disorders (MDD), which includes fatigue as one of the nine DSM-IV criteria, is often associated with similar sleep complaints to CFS (cf Benca et al., 1992).

Both population and clinically based studies showed that the most prevalent complaint within the eight CDC criteria is sleep (Sharpe, 1991; Jason et al., 1999; Reyes et al., 2003; Unger et al., 2004). CFS patients usually describe their sleep as non-refreshing or light. When they occasionally have a better than usual night, patients do report improved mental or physical effort the next day, supporting the importance of sleep in the pathophysiological process of fatigue.

Laboratory studies of polysomnography and quantitative sleep electroencephalographic (EEG) have identified a cluster of sleep abnormalities associated with CFS, summarized in Table 1. With regard to quantitative sleep EEG measures, excessive alpha (8–12 Hz) waves during SWS (“alpha-delta-sleep”, or “alpha-intrusion”) were reported in earlier studies (Hauri and Hawkins, 1973) with mixed support in more recent work (Whelton et al., 1992; Krupp et al., 1993). Alpha-delta sleep has also been described in fibromyalgia ( Harding, 1998), and conditions involving pain, such as Lyme’s disease (Greenberg et al., 1995), irritable bowel (Shen and Soffer, 2001) or migraine (Dowson and Jagger, 1999) and in healthy controls (Moldofsky et al., 1975; Conneman et al., 2001). Moreover, links were found between alpha-delta and anxiety symptoms, but not fatigue (Van Hoof et al., 2007). A comprehensive review (Mahowald and Mahowald, 2000) identified a number of methodological factors contributing to discrepancies among studies, including: lack of

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appropriate control subjects, non-standardized EEG recording techniques and the difficulties in visual scoring of EEG frequency events. However, studies that have attempted to these methodological concerns have often reported very subtle differences between CFS patients and healthy controls (Armitage et al., 2007, 2009). One study only identified lower delta power in CFS under sleep challenge conditions but did not find evidence of increased alpha–delta sleep or polysomnographic abnormalities in CFS (Armitage et al., 2007). By contrast, one study reported higher delta in CFS (Guilleminault et al., 2006). Thus, even when methodological issues are addressed, the findings have remained contradictory.

Although the role of delta sleep EEG is not fully understood, it has been the focus of many studies on CFS. Delta sleep EEG is homeostatically regulated (Borbély, 1982) and intensifies as a function of prior wake duration. It has been hypothesized to reflect the restorative aspect of sleep and is often associated with “feeling rested” after sleep. Sleep disturbances in a number of clinical disorders have been associated with reduced delta EEG or impaired homeostasis, including major depressive disorders (Armitage et al., 2007, 2009). One study only identified lower delta power in CFS under sleep challenge conditions but did not find evidence of increased alpha–delta sleep or polysomnographic abnormalities in CFS (Armitage et al., 2007). By contrast, one study reported higher delta in CFS (Guilleminault et al., 2006). Thus, even when methodological issues are addressed, the findings have remained contradictory.

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