A New Method of Sleep Staging Based on a Reduced Montage Using 2 EOG channels

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The Methodological Question Being Addressed: Currently, objective assessment of sleep architecture and sleep continuity in clinical trials relies on the recording of distinct biological signals (at least electroencephalography - EEG, electrooculography - EOG and electromyography - EMG) for a full night. This method – called polysomnography (PSG) – is usually performed at specialized sleep labs requiring skilled personnel and full equipment, and – being expensive and to some extent burdensome for the patient – limits the number of measurements to only a few nights in a trial protocol. This might not be representative for a patient's sleep. Portable solutions for sleep measurement are gaining increasing acceptance based on published evidence. Currently, however, most such solutions still rely on the availability of a full montage according to the published standards (AASM 2007), preventing the easy self-applicability and thus limiting the potential scope of those instruments. Thus, a portable, less intrusive and self-applicable solution for sleep measurement would allow for the acquisition of more nights in the patient's familiar environment.

Aims: The aim of this paper is to investigate whether a reduced electrode montage, restricted to 2 EOG channels only, can yield sleep staging results comparable to a full montage.

Methods: PSG recordings from 36 healthy controls (2 nights each) had been analyzed using a validated computer assisted scoring system (Anderer et al. 2010). For this study, only the standard 2 EOG channels were used as input data and submitted to a modified version of the analyzer.

Results: The main 3 states wakefulness (r=0.87), NREM sleep (r=0.77) and REM sleep (r=0.68) were identified effectively (full montage versus reduced montage). On an epoch by epoch basis, Cohens Kappa is 0.65 with agreement rates of 86% for W, 81% for SWS, and 84% for REM, respectively. However, for N1 (52%) and N2 (66 %) agreement is not yet satisfactory, which is probably due to weak representation of sleep spindles in the present setting and might be improved by implementing a more sensitive spindle detection in a next step.

Conclusions: This work provides promising evidence that, with the proper modification of existing computer-based sleep scoring solutions, a reduced montage permits sleep measurements that lead to results comparable to full PSG, at least with respect to many important sleep variables.

Disclosure:

The authors are employees and shareholders of The Siesta Group