Diagnostic value of sleep stage dissociation as visualized on a 2-Dimensional sleep state space in human narcolepsy

Anders Vinther Olsen\textsuperscript{a,b}, Jens Stephansen\textsuperscript{a,b}, Eileen Leary\textsuperscript{a}, Paul E Peppard\textsuperscript{d}, Hong Sheungshul\textsuperscript{e}, Poul Jenum\textsuperscript{c}, Helge Sorensen\textsuperscript{b}, Emmanuel Mignot\textsuperscript{a}

\textsuperscript{a}Center for Sleep Sciences and Medicine, Stanford School of Medicine, Palo Alto, California, USA
\textsuperscript{b}Department of Electrical Engineering, Technical University of Denmark, Kongens Lyngby, Denmark
\textsuperscript{c}Danish Center for Sleep Medicine, Department of Clinical Neurophysiology, Rigshospitalet, Denmark
\textsuperscript{d}Department of Preventive Medicine, U Madison Wisconsin Madison, Wisconsin, USA
\textsuperscript{e}Sleep Disorder Center, Catholic University, Seoul, Korea

Abstract

Background: Type 1 narcolepsy (NT1) is characterized by symptoms believed to represent Rapid Eye Movement (REM) sleep stage dissociations, occurrences where features of wake and REM sleep are intermingled, resulting in a mixed state. We hypothesized that sleep stage dissociations can be objectively detected through the analysis of nocturnal Polysomnography (PSG) data, and that those affecting REM sleep can be used as a diagnostic feature for narcolepsy.

New Method: A Linear Discriminant Analysis (LDA) model using 38 features extracted from EOG, EMG and EEG was used in control subjects to select features differentiating wake, stage N1, N2, N3 and REM sleep. Sleep stage differentiation was next represented in a 2D projection. Features characteristic of sleep stage differences were estimated from the residual sleep stage probability in the 2D space. Using this model we evaluated PSG data from NT1 and non-narcoleptic subjects. An LDA classifier was used to determine the best separation plane.

Comparison with existing methods: This method replicates the specificity/sensitivity from the training set to the validation set better than many other methods.

Results: Eight prominent features could differentiate narcolepsy and controls in the validation dataset. Using a composite measure and a specificity cut off 95% in the training dataset, sensitivity was 43%. Specificity/sensitivity was 94%/38% in the validation set. Using hypersomnia subjects, Specificity/sensitivity was 84%/15%. Analyzing treated narcoleptics the Specificity/sensitivity was 94%/10%.

Conclusion: Sleep stage dissociation can be used for the diagnosis of narcolepsy. However the use of some medications and presence of undiagnosed hypsomnolence patients impacts the result.

Keywords: Narcolepsy, Diagnostic, Sleep Stage Dissociation, Machine learning, LDA classifier

2016 MSC: 60G35 92C55 94A12

1. Introduction

Type 1 narcolepsy, a disorder caused by a loss of hypocretin neurons, is diagnosed based on the presence of daytime sleepiness, cataplexy, and a positive Multiple Sleep Latency Test (MSLT). The MSLT is a 4 to 5 daytime nap test opportunity where sleep latency and the occurrence of REM sleep within 15 minutes of onset is noted in each test, a feature called a Sleep Onset REM Period (SOREMP). The MSLT is performed following a night of nocturnal polysomnography (PSG) , a procedure mostly performed to exclude confounding sleep disorders and note for the presence of a nocturnal SOREMP, a highly predictive diagnostic feature.

The cause of hypocretin cell loss in narcolepsy type 1 is likely of autoimmune origin. The disorder is strongly associated with HLA-DQB1*06:02, and has been shown to be triggered by upper airway infections such as streptococcus and influenza-A, notably 2009H1N1 \[1\] \[2\]. Documentation of low cerebrospinal fluid hypocretin 1 (csf-hcrt-1) below 110 pg/ml, is regarded as a definitive diagnostic test for diagnosing narcolepsy type 1 \[3\] \[4\].
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات