

POSTER PRESENTATION

Open Access

Chronic upper airway obstruction induces abnormal sleep/wake dynamics in juvenile rats

Gideon Gradwohl^{1,3*}, Nilly Berdugo-Boura^{1,2}, Yael Segev², Ariel Tarasiuk¹

From The Twenty Third Annual Computational Neuroscience Meeting: CNS*2014
Québec City, Canada. 26-31 July 2014

Traditional scoring of sleep provides little information about the process of transitioning between vigilance-states.

We hypothesized that chronic upper airway obstruction (UAO) will lead to sleep instability in the absence of frank obstructed apneas or hypopneas.

Using an approach similar to previous reports [1,2] defined a 2-dimensional (2D) state space technique (SST) using 2 spectral amplitude ratios calculated by dividing integrated spectral amplitudes at selected frequency bands. We calculated two spectral amplitude ratios by integrating the spectral amplitude over specific frequencies: 0.5-20/

0.5-40 Hz for ratio 1 and 0.5-4/0.5-9 Hz for ratio 2. Each second of this ratio was mapped into the 2D state space, ratio 2 vs. ratio 1 (Figure 1). State space analysis yields wake at low ratio 1 values and SWS at high ratio 1 values. We used the SST to explore whether the abnormal sleep in UAO reflects sleep instability, faster movements, and abnormal transitions between vigilance-states.

We analyzed whole day electroencephalography sleep/wake recordings of UAO and sham control juvenile Sprague-Dawley rats using SST. SST is a non-categorical approach allowing quantitative and unbiased examination of sleep/wake states and state transitions. Measurements of

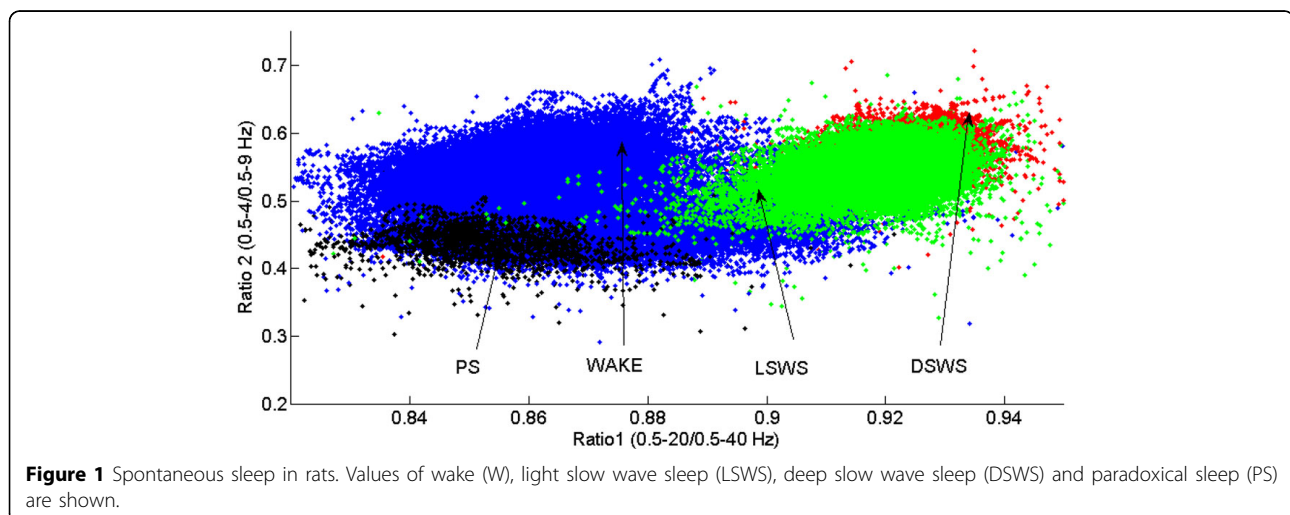


Figure 1 Spontaneous sleep in rats. Values of wake (W), light slow wave sleep (LSWS), deep slow wave sleep (DSWS) and paradoxical sleep (PS) are shown.

* Correspondence: gidi.gradwohl@gmail.com

¹Sleep-Wake Disorders Unit, Soroka University Medical Center and Department of Physiology, Faculty of Health Sciences, Ben-Gurion University of the Negev, 84110, Israel

Full list of author information is available at the end of the article

sleep/wake recordings were performed at baseline and following administration of ritanserin (5-HT₂ receptor antagonist) the next day to stimulate sleep.

UAO rats spent less time in deep (delta-rich) slow wave sleep (SWS) and near transition zones between states. Sleep state transitions were more frequent and rapid in UAO rats, indicating that obstructed animals have more regions where vigilance-states are unstable. The number of microarousals and trajectories from light SWS to wake and vice versa increased in the UAO group. Ritanserin consolidated sleep in both groups by decreasing the number of microarousals and trajectories between wake to light SWS, and increasing deep SWS in UAO.

Conclusions

Traditional sleep scoring in 10-second epochs reveals little information about the process of transitioning between states, as cortical activity and behavior can change quite rapidly in rodents; the SST analysis provides second-by-second resolutions. Also, conventional scoring simply identifies discrete states, so it can overlook important variations within states, such as the distinctions between light and deep SWS or between sleep and wake states. We present evidence that SST enables visualization of vigilance-state transitions and velocities that were not evident by traditional scoring methods. These observations provide new insight on abnormal sleep and highlight the usefulness of SST in understanding the role of UAO on sleep dynamics.

Authors' details

¹Sleep-Wake Disorders Unit, Soroka University Medical Center and Department of Physiology, Faculty of Health Sciences, Ben-Gurion University of the Negev, 84110, Israel. ²Shraga Segal Department of Microbiology and Immunology, Faculty of Health Sciences, Ben-Gurion University of the Negev, 84110, Israel. ³Unit of Biomedical Engineering, Department of Physics, Lev Academic Center, Jerusalem, 9116001, Israel.

Published: 21 July 2014

References

1. Gervasoni D, Lin SC, Ribeiro S, Soares ES, Pantoja J, Nicolelis MA: **Global forebrain dynamics predict rat behavioral states and their transitions.** *J Neurosci* 2004, **24**:11137-11147.
2. Diniz Behn CG, Klerman EB, Mochizuki T, Lin SC, Scammell TE: **Abnormal sleep/wake dynamics in orexin knockout mice.** *Sleep* 2010, **33**:297-306.

doi:10.1186/1471-2202-15-S1-P210

Cite this article as: Gradwohl *et al.*: Chronic upper airway obstruction induces abnormal sleep/wake dynamics in juvenile rats. *BMC Neuroscience* 2014 **15**(Suppl 1):P210.

**Submit your next manuscript to BioMed Central
and take full advantage of:**

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

