

Neural correlates of sustained attention under sleep deprivation during a constant routine: circadian and homeostatic interaction

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Objective: Sustained attention refers to the ability to maintain attention over extended periods of time. The interaction between circadian and homeostatic processes regulates time-of-day modulation in alertness and sustained attention. We investigated the neural correlates of sustained attention during a 42-h constant routine, while participants performed the psychomotor vigilance task (PVT) during successive 13 functional magnetic resonance imaging (fMRI) sessions.

Methods: Thirty-three healthy young volunteers (age 19 – 26; 17 women) participated to the study. Analyses aimed at characterizing the modulation of cerebral responses induced by PVT across fMRI sessions. Objective (theta wake EEG activity) or subjective (Karolinska Sleepiness Scale, KSS) measures of sleepiness were used as regressors in these fMRI analyses.

Results: Data revealed significant activation/deactivation patterns in a well known attentional brain network. This network included the middle frontal gyrus, intraparietal sulcus, middle occipital gyrus and cerebellum (all P corr < 0.05). Interestingly, these areas were observed irrespective of the type of regressor used (theta activity and KSS). Furthermore, analyses of these fMRI brain areas estimates across sessions showed both sinusoidal (circadian) and quasi-linear (homeostatic) patterns.

Conclusion: Our results indicate that cerebral response to a sustained attention task is similarly modulated by both subjective and objective sleepiness across time. Moreover, both circadian and homeostatic factors modulate the hemodynamic responses within this fronto-parieto-occipital network.

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