S90 Circadian and homeostatic modulation of cognition-related cerebral activity in humans

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Brain mechanisms involved in the maintenance of wakefulness and associated cognitive processes are affected by inter-individual differences in sleep-wake regulation. For instance, different time-ofday and sleep-wake related modulations in cognition-associated cerebral activity are chronotype and PERIOD3 genotype dependent. However, the respective contributions of circadian and homeostatic processes on neurobehavioral performance and their cerebral correlates throughout the 24-h cycle remain largely unexplored. In a current project, we further investigate the impact of these processes on the cerebral correlates underlying human cognition in a 40-h multiple nap (NP) and sleep deprivation (SD) protocol. Results: In this ongoing study we have observed that the circadian and sleep-wake homeostatic modulation in subjective sleepiness and objective vigilance undergoes considerable inter-individual differences. Electrophysiological data report the classical slow wave sleep rebound or decrease observed during the recovery night after the SD and NP conditions respectively. A preliminary analysis of the fMRI data, comparing task-related BOLD activity while performing the psychomotor vigilance task during the biological night (3 h before ª 2012 The Authors Journal of Sleep Research ª 2012 European Sleep Research Society, JSR 21 (Suppl. 1), 1–371 Symposium – Circadian and Homeostatic Regulation of Sleep and Wakefulness: an Integrative Approach 13 scheduled wake up time) in the first 11 participants indicated that differential homeostatic sleep pressure levels (SD versus NP) exert an effect on task-related BOLD activity. Globally, cortical responses (e.g. inferior frontal, middle temporal, insula) are higher while performing intermediate reaction time levels on the PVT when sleep pressure is kept low by multiple naps. When looking at BOLD activity underlying optimal PVT performance, at the end of the biological night, the preliminary results indicate that hypothalamic responses as well as several cortical areas (e.g. bilateral insula) are more active under NP as compared to SD conditions. Whether the above mentioned inter-individual variations in neurobehavioral performance are paralleled by differences in cognition-related BOLD activity is currently being analysed. Conclusion: Time of day and disproportional homeostatic sleep pressure affect neurobehavioral performance modulation, which is mirrored at the cerebral level. The existence of large inter-individual variability in the vulnerability to circadian and/or homeostatic related detrimental effects on neurobehavioral performance should be taken into account in future analyses. This work was supported by the Swiss National Science Foundation # 310030_130689 to CC