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LOCAL SLEEP-LIKE EVENTS IN AWAKE ASTRONAUTS

Abstract

In this paper we investigate how sleep deficiency reported by most astronauts in space impacts sleep pressure by exploring topographical changes in waking electroencephalography (EEG) data, based on the analysis of human wake EEG data acquired on board of the international space station (ISS) during the Neurospat experiment. This unique data allows studying local sleep-like events during wakefulness in 5 astronauts throughout their 6 months' mission.

Adequate sleep quantity and intensity is required for optimal vigilance, cognitive and learning processes, which presumably is related to sleep's critical function in neuroplasticity [1].

Regulated separately but in concomitance with the circadian process, the homeostatic process, represented by sleep pressure, builds up with the time spent awake. Markers of high sleep pressure can be observed during wakefulness, by increased theta activity (5-8Hz), and, while asleep, by an increase of delta activity (0.5-4Hz), also termed slow wave sleep [3].

The local regulation of slow wave sleep seems to be closely related to the capacity for neuroplastic changes [1]. Recently, it has been shown that similar local sleep-like events can be observed in awake rodents [4]. Using scalp electroencephalography (EEG), local sleep-like events have also been studied after a period of sleep deprivation in awake humans [5].

Experimental evidence indicates that astronauts tend to experience sleep deficiency on board of the international space station (ISS), at least until their circadian clock is realigned with the new environment [6].

We analyse how sleep deficiency reported by most astronauts in space impacts local sleep-like events, based on data collected between 2011 and 2013, as part of Neurospat experiment, on 5 male astronauts [7]. The astronauts were tested three times on earth before the experiment, twice during the mission and four times at their return to earth. 1 min of open eyes / resting state waking EEG data was recorded in the beginning of the experimental protocol. In addition, a 1 min recording, after performing the experiment for 70 min (visuo-motor task) is analyzed.

To detect evidence of local sleep-like events during wakefulness, we are extracting theta waves from the recordings by combining existing methods [8][5][9][10][11].