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The influence of sodium oxybate and sleep on reward processing: an fMRI study

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Objective: Sodium oxybate (SO; Xyrem®) has been approved in most countries for treatment of narcolepsy with cataplexy. It acts as a GABA(B) receptor agonist, improving disrupted sleep, decreasing sleep onset latency, and increasing slow waves activity (SWA) in narcoleptic patients as well as in healthy subjects. Here, we tested (1) whether SO influences brain network related to reward processing and (2) whether changes in sleep induced by SO affect reward processing in healthy subjects on the next day.
Method: Nineteen subjects were given SO or placebo (PL) over 2 distinct fMRI sessions. Each subject performed a game-like task after SO/PL administration in an evening session (1). PSG was recorded in the following night. On the next day, a second session of game-like task was performed during the afternoon (2). During the game-like task, subject could win or lose points by rapidly detecting a target. We compared brain activity during winning or losing points after SO or PL, during the evening session and after the sleep.
Results: At behavioural level, subjects detected the target more rapidly after negative cues (potential losses) immediately after SO, suggesting increased risk aversiveness in these subjects. Subjects also often pressed too early under SO for positive cues (potential gains), suggesting an increased impulsivity for obtaining rewards. After one night of sleep under SO (vs PL), we observed no other modification in reaction times.
At the fMRI level, during the evening session, subjects under direct influence of SO (as compared to PL) showed significant activation in an error monitoring network (including the anterior cingulate) when they are losing for cues signaling large potential gains, and activated significantly more a network related to reward processing (including the ventral putamen) when they are actually winning for these same cues, suggesting that SO enhances reward sensivity. After a night of sleep modified by SO (vs PL), we found a significant activation of the bilateral amygdala and right insula when subjects lost large amounts of points, suggesting that changes in sleep after SO administration may have an effect on error processing and emotional reactivity on the next day. The analysis of sleep data will be also presented.
Conclusion: SO (as compared to PL) influences reward functions at both the behavioral and brain level.

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