13.067 - Hippocampal Theta Oscillations and Cross-Frequency Coupling during Spatial Decision-Making

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Abstract

Introdução

The processing of spatial and mnemonic information is believed to depend on hippocampal theta oscillations (5-12 Hz). However, in rats both the power and frequency of the theta rhythm are modulated by locomotor activity, which is a major confounding factor when estimating its cognitive correlates. Previous studies have suggested that hippocampal theta oscillations and its modulation of higher frequency rhythms support decision-making processes.

Objetivos

In the present study, we investigated to what extent spatial decision-making modulates hippocampal theta oscillations when controlling for variations in locomotion speed. In addition, we measured how the amplitude of low-gamma (25-50 Hz), high-gamma (60-90 Hz), and high-frequency oscillations (>100 Hz) is modulated by the phase of theta oscillations (cross-frequency coupling).

Métodos

We recorded local field potentials from the CA1 region of 5 male Wistar rats while animals had to choose one arm to enter for reward (goal) in a four-arm radial maze. The animals were previously trained to achieve 70% of correct choices and four sessions were used to the analyses. We then analyzed intervals of inter-trial period (DELAY), decision-making (DM), and running to reward (RUN). Trials with similar locomotion speed were used to compare theta power across intervals. We measured cross-frequency coupling within each interval and temporally triggered to the end of DM.

Resultados e Conclusões

We observed prominent theta oscillations and strong phase modulation of gamma amplitude during DM interval of the task, which occurred in the center of the maze before animals deliberately ran through an arm towards goal location. In speed-controlled analyses, theta power and frequency were higher during the decision period when compared to either an inter-trial delay period (also at the maze center), or to the period of running towards goal location (p<0.05, two-way ANOVA followed by Tukey's post hoc test). Moreover, theta activity was higher during decision intervals preceding correct choices than during decision intervals preceding incorrect choices (p<0.05, Student's t-test). Altogether, our data support a cognitive function for the hippocampal theta rhythm in spatial decision-making.

Keywords: Oscillations, Local field potential, Spatial choice, Speed, Radial maze

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