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RESEARCH AREA

Unraveling the fundamental operational principles of subcortical modulation.

In recent years, there has been significant progress in our understanding of brain function and the establishment of dynamically changing neuronal circuits, which form the basic elements of a 'thought'. However, still little is known about the mechanism of subcortical modulation, which are responsible for the formation of our emotions, and influence our cortical function and memory processes. We are particularly interested in the connection between the hippocampus and two of its main modulatory inputs: the medial septum (MS) and the median raphe (MR). The activity of the MR is strongly associated with the formation of negative emotions, while the MS is thought to play a pivotal role in orchestrating the activity of hippocampal coding neuronal assemblies. Given the hippocampus's crucial role in the memory formation, our project aims to investigate the effect of subcortical regulatory circuits (MS, MR) on hippocampal information processing at different contexts. We monitor neuronal activity using multichannel electrodes in awake, behaving mice and identify specific cells using optogenetic techniques.

TECHNIQUES AVAILABLE IN THE LAB

- Patch-clamp technique in head-restrained awake behaving mice
- Multichannel recording in head-restrained awake behaving mice
- Optogenetics
- Different surgery techniques (virus injection, headpost surgery etc.)
- Immunohistology

SELECTED PUBLICATIONS

Barth M.A., Jelítai M.*, Vasarhelyi-Nagy M.F., Varga V. (2023) Aversive stimulus-tuned responses in the CA1 of the dorsal hippocampus. **Nat Comm 14**: 1 Paper: 6841.

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Kiraly B., Domonkos A., Jelítai M., Lopes-dos-Santos V., Martine-Bellver S., Kocsis B., Schlinoff D., Joshi A., Salib M., Fiath R., Bartha P., Ulbert I., Freund T.F., Viney T.J., Dupret D., Varga V., Hangya B. (2023) The medial septum controls hippocampal supra-theta oscillations. **Nat Comm 14**: 1 Paper: 6159.

Jelítai M., Barth M.A., Komlósi F., Freund T., Varga V.: (2021) Activity and Coupling to Hippocampal Oscillations of Median Raphe GABAergic Cells in Awake Mice. **Front Neural Circuits 15**: 17 Paper: 784034, 12 p.

Jelítai M, P. Puggioni, T. Ishikawa, A. Rinaldi, I. Duguid: (2016) Dendritic excitation-inhibition balance shapes cerebellar output during motor behavior. **Nat Commun. 7**: 13722.

Puggioni P, Jelítai M., Duguid I., van Rossum MC. (2017) Extraction of synaptic input properties in vivo. **Neural Comput 29(7)**: 1745-1768.