Memory processing after neuron loss in the entorhinal cortex and hippocampus

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Country

USA

Title of project or programme

Memory processing after neuron loss in the entorhinal cortex and hippocampus

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NIH (NIA)

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01/03/2014

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3

The project/programme is most relevant to:

Alzheimer's disease & other dementias

Keywords

entorhinal cortex, memory process, neuron loss, Medial, Hippocampus

Research Abstract

DESCRIPTION (provided by applicant): Neuron loss and the reorganization of neural circuits in the medial temporal lobe are hallmarks of traumatic brain injury, temporal lobe epilepsy, brain

ischemia, and Alzheimer's disease. Various degrees of memory impairments are among the troubling symptoms of each of these diseases, but the exact pattern of histopathology varies between diseases. The memory loss that is common to the diseases is thought to emerge from entorhino-hippocampal dysfunction. The entorhinal cortex and hippocampus function as a feedback loop and a loss of function could thus emerge by disrupting neuronal processing when damaging any part of the circuit. Alternatively, each subregion within the circuit may be able to independently perform its characteristic function, but different pattern of neuronal injury within the medial temporal lobe might nonetheless manifest in a common way because the entorhinal cortex and hippocampus can only incompletely compensate for each other's function. Although questions about the mechanisms of neural dysfunction can be studied in animal models that are specific for a neurological disease, an understanding of the sources for memory problems can also be obtained from investigating different patterns of injury within the medial temporal lobe. Because many cell types for spatial processing have been described in the medial entorhinal cortex (MEC) and hippocampus, we propose to initially focus on these brain regions. We have begun to investigate the extent of spatial memory impairments after lesions to the rat hippocampus and/or MEC. Our preliminary data show substantial dysfunction of spatial and temporal processing in the hippocampus after MEC lesions and in the MEC after hippocampal lesions. We also find that memory impairments are less severe after lesions to individual brain regions compared to combined lesions. Based on our preliminary results, we hypothesize that spatial functions can, in part, be independently performed by the MEC and the hippocampus, but that temporal aspects of MEC and hippocampal neuronal processing require that the entire loop be intact. This hypothesis will be tested in three aims: (1) further characterize memory dysfunction after complete MEC lesions and after combined lesions of the MEC and the hippocampus with behavioral testing, (2) determine the extent of neuronal network dysfunction in hippocampus after MEC lesions with single-unit recordings during behavior, and (3) determine which neuronal firing patterns in MEC are disrupted after complete hippocampal lesions and, additionally, identify whether neuronal computations in the MEC can be restored by brain stimulation. Identifying spared functions after different patterns of damage and revealing how manipulations of the remaining circuits can compensate for lost functions will provide insight into the network mechanisms that can be strengthened or restored in neurological and neurodegenerative diseases.

Lay Summary

PUBLIC HEALTH RELEVANCE: Neuron loss and/or the reorganization of neural circuits in the hippocampal formation are hallmarks of neurological and neurodegenerative diseases, such as traumatic brain injury, temporal lobe epilepsy, brain ischemia, and Alzheimer's disease. Because the hippocampal formation, which includes the entorhinal cortex, the dentate gyrus, and the hippocampal CA regions, is essential for forming episodic and semantic memories, a common and troubling symptom in diseases in which any of the subregions within the hippocampal formation is affected is a devastating loss of memory. Identifying the function of neural circuits for memory, including the function of partially damaged circuits, is a critical stes for developing treatments to prevent or ameliorate memory problems and to combat the personal and societal cost of memory loss.

Further information available at:

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Investments > €500k

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United States of America

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Alzheimer's disease & other dementias

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