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Impact of early life stress on cognition, behavior and hippocampal neuronal plasticity in female mice

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Motivation and Aim: Hippocampus is a crucial part of limbic system that involved both in the cognitive processing such as memory and in the regulation of responses to stress. In the rodent, the first postnatal weeks are crucial time for the hippocampal development. Adverse experiences in early life can disrupt neural and behavioral development and impairment of the HPA-axis responsive to subsequent stressors. However, how early-life stress lead to delayed behavioral impairments in adult remains relatively uncertain.
Methods and Algorithms: In our study, two types of early life stress were used: prolonged separation of pups from their mothers (for 3h/day, maternal separation-MS) and brief separation (for 15min/day, handling-HD). In first part of our study, we analyzed the effects of early-life stress on cognition (by using Morris water maze and Novel object recognition tests). As markers of neuronal and synaptic activities number of mature neurons (NeuN+ cells) and level of expression of immediate early genes (qPCR) in the hippocampus as well as number of maturing neurons (DCX+ cells) and number of proliferating neurons (Ki676+ cells) in the dentate gyrus were measured. We examined only female mice, since they are much less investigated, but often more sensitive to stress than males. In second part of our study, we investigated the level of maternal care of females with history of early life stress as a key female behavior, which is dependent on both hippocampus and HPA-axis.
Results: We found that adult female mice in the MS group demonstrated reduced locomotor activity, spatial long-term and recognition memory impairments and reduced level of maternal care, while the HD group showed mild changes. Additionally, MS in early-life resulted in reduced number of mature neurons in the CA3 area of the hippocampus that is crucial for learning and memory.
Conclusion: Thus, prolonged maternal separation but not brief leads to memory and behavioral impairments and reduced number of neurons in the CA3.
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