Study of the emotionally challenged behavior in \(\gamma\)-synuclein knock-out mice

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Introduction

\(\gamma\)-synuclein is a member of the synuclein family of cytoplasmic and predominantly neuronal proteins that appeared late in evolution and described in vertebrates only. In axons and presynaptic terminals of neurons of regions involved in emotions, learning and memory substantial amounts of \(\gamma\)-synuclein has been detected. The role of \(\gamma\)-synuclein in these brain functions was not previously assessed. We have demonstrated for the first time that the loss of \(\gamma\)-synuclein results in significant increase of orientation response in the new situation conditions, elevated risk tolerance and decrease of state anxiety.

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Novel cage test

A - exploratory activity of experimental animals expressed in minutes; B - total values of exploratory activity during 5 min observation period.

WT - control animals (with normal unmodified \(\gamma\)-synuclein gene), \(\gamma\)\(-\)\(\gamma\)-synuclein knockout animals.

** - \(p<0.01\), *** - \(p<0.001\) (Student t-test).

Activity in the open field

The diagrams shows means of 13 behavioural parameters assessed for two genotype groups of mice in two illumination conditions. A - each behavior parameter for \(\gamma\)-synuclein knockout mice measured in conditions of conventional (60 lx) or anxiogenic (450 lx) illumination is displayed as percent of the same parameter for wild type mice measured in the same conditions. Statistically significant difference between genotypes for data obtained in conventional are shown (**– \(p<0.01\), Student t-test). B - effect of anxiogenic (450 lx) illumination on the behavior of wild type (WT) and \(\gamma\)-synuclein knockout (\(\gamma\)-) mice. Each behavior parameter is expressed as percent of the same parameter measured in condition of conventional illumination (60 lx) for mice of the same genotype. Statistically significant difference between illumination conditions for wild type and \(\gamma\)-synuclein knockout mice are shown (**– \(p<0.01\); Student t-test).

Elevated o-maze test

Bar charts show means\(\pm\)s.e.m. of experimental values obtained by testing wild type (WT) and \(\gamma\)-synuclein knockout (\(\gamma\)-) mice. A - latency to enter the open sector of the maze (sec), B - total time spent in the open section (sec); C - total number of the open sector entrances (number of entrances). Where appropriate a statistically significant difference is shown (**– \(p<0.01\), ***– \(p<0.001\); Student t-test).

Results and discussions

We identified significant differences in emotional behavior mediated between the group of control animals and \(\gamma\)-synuclein knockout mice (\(\gamma\)-KO). The lack of \(\gamma\)-synuclein gene has the following consequences. We determined that there was an increase in the orienting response to the new situation in the test “Novel Cage” and “O-shaped elevated maze”. Secondly, the distinguishing feature in \(\gamma\)-KO mice was the high risk tolerance which was evaluated by the increased time that mice spent in non-fenced segment of the O-shaped maze. This parameter was also confirmed by the amount of time that group of \(\gamma\)-KO mice spent in the center of open field after a single presentation with stress factors (e.i. high illumination). The study of the general anxiety of \(\gamma\)-KO mice indicates its reduced level in the relation to the levels of anxiety of the control animals. These findings were confirmed the results obtained in the test “O-shaped elevated maze” and the motor activity in the open-field test. We found that \(\gamma\)-synuclein is directly involved in the regulation of functions of the higher nervous activity.

References