Methylphenidate has long-lasting metaplastic effects in the prefrontal cortex of adolescent rats

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Methylphenidate (MPH) is widely used as a "nootropic" agent and in the treatment of disorders of attention, and has been shown to modulate synaptic plasticity in vitro. Here we present in vivo evidence that this MPH-induced metaplasticity can last long after the end of treatment. MPH (0, 0.2, 1 and 5. mg/kg) was administered daily to male rats from postnatal day 42 for 15 days. The animals were tested daily in a radial maze. Long-term potentiation (LTP), a marker of neural plasticity, was induced in vivo in the prefrontal cortex after 2-3. h, 15-18 days or 5 months without treatment. The behavioral performance of the 1. mg/kg group improved, while that of animals that had received 5. mg/kg deteriorated. In the 1 and 5. mg/kg groups LTP induced 2-3. h after the last MPH treatment was twice as large as in the controls. Further, 15-18 days after the last MPH administration, in groups receiving 1 and 5. mg/kg, LTP was about fourfold higher than in controls. However, 5 months later, LTP in the 1. mg/kg group was similar to controls and in the 5. mg/kg group LTP could not be induced at all. No significant changes of LTP were seen in the low-dose group of animals (0.2. mg/kg). Thus, firstly, doses of MPH that improve learning coincide approximately with those that augment LTP. Secondly, MPH-induced increases in LTP can last for several weeks, but these may disappear over longer periods or deteriorate at high doses. © 2015 Elsevier B.V.

Long-term potentiation

Metaplasticity

Methylphenidate

Prefrontal cortex

methylphenidate

central stimulant agent

methylphenidate

nootropic agent

animal experiment

Article

controlled study

experimental behavioral test

in vivo study

learning

long term potentiation

male

mental performance

metaplasticity

nerve cell plasticity

nonhuman

perinatal period

prefrontal cortex

priority journal

radial arm maze test

rat

task performance

animal

dose response

drug effects

growth, development and aging

maze test

microelectrode

physiology

prefrontal cortex

Sprague Dawley rat

Animals

Central Nervous System Stimulants

Dose-Response Relationship, Drug

Long-Term Potentiation

Male

Maze Learning

Methylphenidate

Microelectrodes

Nootropic Agents

Prefrontal Cortex

Rats, Sprague-Dawley