Abstract

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Metabolic changes in rat prefrontal cortex and hippocampus induced by chronic morphine treatment studied ex vivo by high resolution 1H NMR spectroscopy.

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OBJECTIVE AND METHODS: Ex vivo(1)H NMR spectroscopy was used to measure changes in the concentrations of cerebral metabolites in the prefrontal cortex (PFC) and hippocampus of rats subjected to repeated morphine treatment known to cause tolerance/dependence.

RESULTS: The results show that repeated morphine exposure induces significant changes in the concentrations of a number of cerebral metabolites, and such changes are region specific. After 10 days of repeated morphine treatment, the concentration of gamma-aminobutyric acid (GABA) increased significantly in the PFC (20+/-11%), but decreased in the hippocampus (-31+/-12%), compared to control. In contrast, the glutamate (Glu) concentrations in both the PFC (-15+/-8%) and hippocampus (-13+/-4%) decreased significantly. Significant changes were also observed in the concentrations of hippocampal glutamine (Gln), myo-inositol, taurine, and N-acetyl aspartate. These morphine-induced changes were reversed during a subsequent 5-day withdrawal period.

CONCLUSIONS: It is suggested that the observed concentration changes for Glu, Gln and GABA are most likely the result of a shift in the steady-state equilibrium of the Gln-Glu-GABA metabolic cycle. Changes in the metabolism of this neurotransmitter system might be part of the adaptive measures taken by the central nervous system in response to repeated morphine exposure and subsequent withdrawal.

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