Exercise protects against damage causing leakage in the blood-brain barrier

April 21 2009

Regular exercise can prevent the disruption of the blood brain barrier that normally occurs with a dose of methamphetamine comparable to that used by heavy meth users.

A University of Kentucky study is the first to look at the protective effects of exercise on the vascular effects of methamphetamine, effects that have been found clinically to contribute to serious, lasting, and sometimes fatal cardiovascular and neurological problems. Results of the study, conducted in young male mice, were reported April 22 at the Experimental Biology 2009 meeting in New Orleans. The presentation was part of the scientific program of The American Physiological Society.

Principal investigator Dr. Michal Toborek says the level of the protective effects of exercise on the integrity of the blood brain barrier after the human equivalent of one gram of methamphetamine was surprising even to the research team.

The results provide new understanding of the mechanisms through which the brain reacts to methamphetamine, particularly those related to oxidative stress. Results also suggest why exercise might help delay the onset of neurodegenerative diseases such as Alzheimer's and Parkinson's in which leakiness of the blood brain barrier is a characteristic.

The researchers placed 25 young male mice - aged three months, equivalent to the 20s in humans -- in cages where they had access to

exercise wheels. For five weeks, the animals took advantage of the wheels to run continually. Another 25 young mice were housed in similar cages but without access to wheels.

At the end of this "endurance exercise training" period, all mice were injected with 10 mg. of methamphetamine over a 24-hour period. All the mice displayed some of the same effects of meth as seen in humans: they appeared agitated and increased their physical activity, and their body temperature rose. But in terms of what was happening in the capillaries of the brain, there was a marked difference between the mice who had been exercising extensively for the previous five weeks and those who had been sedentary.

In the sedentary group of mice, the small capillaries in the brain experienced increased oxidative stress, causing the blood brain barrier to become more permeable. Toxins and inflammatory cells previously prevented from crossing the blood brain barrier then had access to the brain. The exercise group showed no such changes.

Changes in the blood brain barrier, especially the role of oxidative reactions, have been little studied in the past, says Dr. Toborek; the University of Kentucky study is the first to observe that meth administration produced an upregulation of NADPH oxidase, a major enzyme that causes oxidative stress.

This is a significant finding, says Dr. Toborek, because it delineates a mechanism for how meth causes oxidative stress. It also was significant that the exercise mice were markedly protected from such upregulation and consequently from the oxidative stress that weakened the capillaries in the brains of the non-exercise mice.

Exercise by no means protects against all the harmful effects of meth use, says Dr. Toborek, and the team now plans to study the effects and

mechanisms involved in chronic meth abuse. However, he says, this study adds to the growing amount of data showing the positive and protective health effects of consistent exercise.

Source: Federation of American Societies for Experimental Biology (news : web)