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Cooling the brain prevents cell death in young mice exposed to anesthesia

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New research from Washington University School of Medicine in St. Louis suggests cooling the brain may prevent the death of nerve cells that has been observed in infant mice exposed to anesthesia. The effects of anesthesia on human infants and young children have been debated among neuroscientists, but growing evidence suggests exposure to anesthetic drugs during brain development may contribute to behavioral and developmental delays.

The same researchers previously had reported that when young rodents were exposed to alcohol, anesthetics or anticonvulsants, large numbers of their brain cells died through a process known as neuroapoptosis. This latest work suggests such damage may be preventable.

The new findings are reported today at Neuroscience 2008, the annual meeting of the Society for Neuroscience and the world's largest source of emerging news about brain science and health.

"Cooling the brain seems to be quite effective in suppressing nerve cell death after an infant animal has been exposed to an anesthetic drug," says John W. Olney, M.D., the study's senior investigator and the John P. Feighner Professor of Neuropsychopharmacology. "We don't yet know whether this cooling only temporarily suppresses or whether it permanently prevents this brain damage from occurring. We're currently working to clarify that."

Olney's research team previously had demonstrated that a small dose of

anesthetic drugs, enough to lightly anesthetize an infant mouse for about one hour, was sufficient to trigger neuroapoptosis.

"It has been widely assumed that the benefits of anesthesia can be achieved without adverse consequences," Olney says. "But that assumption has been called into question in recent years by work from our laboratory and others around the world."

In this study, Olney found the anesthetic drugs isoflurane and ketamine increased neuroapoptosis in infant mice at normal or high temperatures. However, hypothermia during exposure to anesthesia blocked neuroapoptosis and also reduced the low level of neuroapoptosis that occurs normally during brain development.

"Some cells fail to make the normal connections that they are supposed to make in order to become integrated into a neural network," he explains. "It's necessary for those cells to die and to be removed from the brain. Cooling the brain also suppresses that process."

If Olney's research team can demonstrate cooling the brain only delays that healthy process temporarily, but permanently prevents unhealthy neuroapoptosis due to anesthesia exposure, the technique may be useful someday in preventing cognitive and developmental problems in some children exposed to anesthesia during surgery.

Olney says it's tricky to demonstrate links between developmental deficits and exposure to anesthetic drugs because the type of deficit can vary depending upon the developmental age at which exposure occurs. Different parts of the brain develop at different times, so exposure during one period of development may have a very different effect than exposure earlier or later in brain development.

"We believe there are certain early periods when the damage is not only

more likely to be severe, but it's also likely to be more widespread throughout different regions of the brain," he says. "Naturally, if more of the brain is involved and damage to those regions is more severe, it's going to cause more pronounced neural and cognitive consequences."

Olney says it is likely that the protective effects of hypothermia can be achieved either by cooling the entire body or by applying a cooling helmet to the head.

In addition, Olney has demonstrated in other research that it may be possible to prevent neuroapoptosis by treating mice with other drugs. He recently reported that the drug lithium may provide similar protection against damage from anesthesia.

Source: Washington University School of Medicine