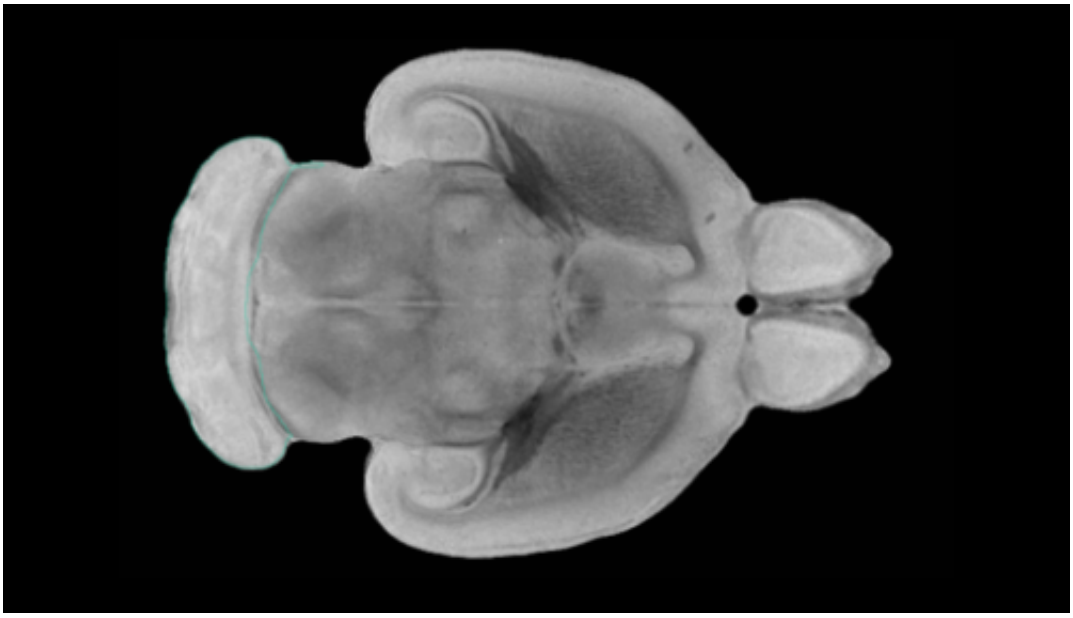
Enhancing sleep after brain injury reduces brain damage and cognitive decline in rats

March 22 2016



Cerebellum of CIVM postnatal rat brain atlas. Credit: Neurolex

Enhancing sleep after a head injury may help prevent some damage to brain cells, according to a study in rats published March 23 in *The Journal of Neuroscience*. Researchers at University Hospital of Zurich, Switzerland found that enhancing the slow-wave cycle of sleep after head trauma minimized damage to axons—the thin extensions that nerve cells use to send signals to other cells—and helped preserve normal brain function. The finding may offer a treatment strategy for a condition that has very few effective therapies.

Traumatic brain injury is a major cause of death and disability worldwide. While brain cells at the site of impact are damaged immediately, many more cells can perish in the hours and days after the trauma as damaged axons succumb to injury. Studies suggest that widespread axonal injury contributes to many of the long-lasting problems with learning, memory, and movement commonly associated with head injuries. Molecular waste products also build up in the brain after head injury. Recent studies indicate the brain clears out this molecular buildup during the slow-wave stage of sleep where brain activity synchronizes into high-amplitude waves.

The researchers led by Daniela Noain and Christian Baumann investigated whether enhancing slow-wave sleep after a head injury could mitigate axonal injury in rats. Twenty-five rats received a blow to the prefrontal cortex, a brain area associated with decision-making and self-control. One-third of the injured rats were sleep-deprived for short periods of time as previous studies indicate, for a brief period of time afterward, sleep deprivation enhances slow-wave sleep. Another group was treated with sodium oxybate, a drug used to induce a slow-wave sleep-like state in narcolepsy patients. A third group received placebo.

One day after injury and continuing for the next five, researchers modulated the animals' sleep. Employing electroencephalography (EEG) recordings during treatment, they confirmed that the animals experienced slow-wave sleep enhancement as a result of treatment. Afterward, the rats took a memory test, and the team examined their brains for axonal damage, focusing on areas involved in learning and memory, including the hippocampus.

They found that rats receiving treatments to enhance slow-wave sleep were better able to recognize familiar objects than the untreated rats. In addition, the researchers found that levels of a biomarker for diffuse axonal injury were reduced nearly 80 percent in animals that had

experienced enhanced sleep compared to untreated rats.

While further study is needed, the work suggests slow-wave sleep administered immediately after a brain injury helps block axon damage and preserve normal brain function, Baumann says.

"Despite the high prevalence of traumatic brain injury worldwide, very few effective treatments exist to mitigate the persistent impairment in memory and cognitive function," says Miranda Lim, a neurologist at Oregon Health & Science University who was not involved in the study. "This study provides important evidence that manipulating sleep may be a promising avenue to enhance recovery after TBI."

Provided by Society for Neuroscience