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Study finds brain regions go offline at different intervals

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(PhysOrg.com) -- A new study shows that, rather than being an "all or nothing" phenomenon, regions of the human brain go silent at different times through the night, losing their ability to communicate during certain phases of sleep.

This discovery may partly explain disorders such as sleepwalking. It also gives humans something in common with dolphins, which are known to sleep with one part of their brain while the other part controls swimming to the surface for air.

"We usually think of sleep as an all-or-nothing event, but these findings reflect a piecemeal type of sleep, in which parts of the brain go off line when others are still communicating," says Dr. Yuval Nir, a post-doctoral researcher in the lab of Dr. Giulio Tononi at the University of Wisconsin School of Medicine and Public Health. "Before this, we weren't entirely sure that there was such a thing as 'local' sleep."

The study done jointly by scientists at the University of Wisconsin and the University of California-Los Angeles (UCLA), examined the sleep of a unique group of 13 epilepsy patients who had electrodes implanted deep into their brains to monitor the sources of their seizures at the Ronald Reagan UCLA Medical Center.

In total, researchers were able to follow the activity recorded by 129 electrodes placed into eight to 12 brain regions per patient. Usually researchers can study human sleep only by recording the waves sensed

through the surface of the skull via scalp EEG.

"Usually when we study sleep, we have to make a choice between using invasive measures in animals or non-invasive measures in human subjects," says Nir. "We would not be able to do this study without neurosurgeon Dr. Itzhak Fried and his patients at UCLA."

They found that despite their epilepsy, the sleep in the patients resembled normal sleep in healthy individuals. In addition, the researchers were able to remove bursts of activity associated with epilepsy from the analysis.

The electrodes recorded activity in 12 regions of the brain. In addition, they recorded scalp EEG, depth EEG, and electrical spikes of individual nerve cells. Researchers found that both slow waves and oscillating spindles, which are electrical markers for sleep, were mostly confined to local regions of the brain.

Nir says that the results show that "local" sleep is more common later in the night. But he compares it to a baseball game, in which different regions of the brain represent baseball fans who eventually need to take a break from the game to go to the restroom or grab a hot dog.

"They all need a seventh-inning stretch, but some of them take it in the sixth inning and some in the eighth," he says. These differences may indicate that sleep is driven by the local regions of the brain, which have different jobs during wakefulness and thus differing needs for rest.

The research is being published in the April 14 edition of *Neuron* and was supported by the European Molecular Biology Organization, the Human Frontier Science Program, the Brainpower for Israel program, and the National Institutes of Health, which supplied several grants including a NIH Director's Pioneer Award to Giulio Tononi.

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