Medical Xpress

Jet lag disturbs sleep by upsetting internal clocks in 2 neural centers

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Jet lag is the bane of many travelers, and similar fatigue can plague people who work in rotating shifts. Scientists know the problem results from disruption to the body's normal rhythms and are getting closer to a better understanding that might lead to more effective treatment.

New University of Washington research shows the disruption occurs in two separate but linked groups of neurons in a structure called the suprachiasmatic nucleus, below the hypothalamus at the base of the brain. One group is synchronized with deep sleep that results from physical fatigue and the other controls the dream state of rapid eye movement, or REM, sleep.

The ventral, or bottom, neurons receive light information directly from the eyes and govern rhythms in tune with periods of light and dark. The dorsal, or top, neurons do not receive direct light information and so govern rhythms as a more independent internal, or circadian, biological clock.

It turns out that some of the body's rhythms are "more loyal" to the ventral neurons and others are much more in tune with the dorsal neurons, said Horacio de la Iglesia, a UW associate professor of biology.

Normally the two neuron groups are synchronized with each other, but disruptions such as jet travel across time zones or shift work can throw the cycles out of kilter. Deep sleep is most closely tied to light-dark cycles and typically adjusts to a new schedule in a couple of days, but REM sleep is more tied to the light-insensitive dorsal neurons and can be out of sync for a week or more.

"When we impose a 22-hour light-dark cycle on animals, the ventral center can catch up but the dorsal doesn't adapt and defaults to its own inner cycle," de la Iglesia said.

In the laboratory rats he uses for his research, that normal cycle is 25 hours. When the artificial 22-hour light-dark schedule was imposed, he found that the rats' deep sleep, largely governed by light but also a response to fatigue, quickly adapted to the 22-hour cycle, while their REM sleep continued to follow a 25-hour cycle. As a result, REM sleep did not occur in a normal progression following deep sleep.

"We found that after exposing rats to a shift of the light-dark timing that simulates a trip from Paris to New York, REM sleep needed 6 to 8 days to catch up with non-REM, or deep, sleep, the sleep you usually experience in the first part of the night," de la Iglesia said.

The two types of sleep overlap immediately after the simulated jet lag occurs, he noted, and there is a greater likelihood of the animals entering REM sleep earlier than they should. That likely explains why it can take several days for travelers and shift workers to adapt to their new schedules, he said.

"It also could explain why jet lag is associated with lower learning performance. We think the disruption of the normal circadian sequence of sleep states is very detrimental to learning," he said.

"One of the problems is that you are doing things at times that your body isn't prepared to do them. One group of neurons tells your body it is Paris time and another says that it is New York time. You are internally desynchronized," said de la Iglesia.

He is lead author of a paper describing the work published online April 16 by *Current Biology*. Co-authors are Michael Lee and Beryl Swanson of the UW. The work was funded by the National Institutes of Health and the Mary Gates Endowment for Students at the UW.

Previous research has indicated that treatments such as physical activity can help the body resynchronize its rhythms following jet lag. The new work, de la Iglesia believes, could be useful in fine-tuning pharmaceutical and other therapies.

"We can go back to the treatments that are believed to be effective and see where they might be acting in the circuitry of these neuron centers, then refine them to be more effective," he said.

Source: University of Washington (news : web)