Study shows how the brain can trigger a deep sleep

February 23 2015

Scientists have discovered that switching on one area of the brain chemically can trigger a deep sleep.

The new study, which explored how sedatives work in the brain's neural pathways, could lead to better remedies for insomnia and more effective anaesthetic drugs.

Scientists from Imperial College London found that certain types of sedative drugs work by 'switching on' neurons in a particular area of the brain, called the preoptic hypothalamus. Their work, in mice, showed that it is these neurons that are responsible for shutting down the areas of the brain that are inactive during deep sleep.

Following a period of sleep deprivation, the brain triggers a process that leads to a deep recovery sleep. The researchers found that the process that is triggered by the sedatives is very similar. In mice, when the researchers used a chemical to activate only specific neurons in the preoptic hypothalamus, this produced a recovery sleep in the animals.

The new research is important because although scientists understand how sedatives bind to certain receptors to cause their desired effects, it had previously been assumed that they had a general effect throughout the brain. The knowledge that one distinct area of the brain triggers this kind of deep sleep paves the way for the development of better targeted sedative drugs and sleeping pills. These new drugs could directly hijack this natural mechanism to work more effectively, with fewer side effects

and shorter recovery times.

"If you don't sleep for a long period, your body shuts down - almost as if you had taken a drug," said study co-author Professor Bill Wisden, from the Department of Life Sciences at Imperial College London. "We've shown that sedative drugs trigger the same neurons, making the two types of unconsciousness very similar."

"Although we know that certain sedatives are effective, there are lots of gaps in scientists' knowledge in terms of precisely what sedatives are doing in the brain. We looked at the class of sedative drugs commonly used for patients undergoing investigative procedures or minor operations, to try and identify the circuitry in the brain that they are affecting," explained Nick Franks, also from the Department of Life Sciences at Imperial College London. "What we found was really striking. Most people might think that sedative drugs would work by directly shutting down certain neural pathways but actually what happened was that they first switched on one particular area - the preoptic hypothalamus - and this then caused other parts of the brain to shut down."

"Lack of sleep is a really serious problem for many people, such as people suffering from stress or people working irregular shifts, and it affects their physical and mental health" added Professor Wisden. "There are many different sleeping pills available but none of them provide rest that is as restorative as natural sleep. We hope that our new research will ultimately lead to new ways of addressing this problem."

In the study, published in *Nature Neuroscience*, the researchers used a genetic tagging system to mark neurons in mice that were activated both during sedation and in recovery sleep. When the researchers subsequently targeted those neurons in the mice with a selective chemical, this was sufficient to produce a recovery sleep in the mice.

The team plan to continue their investigations into sleep induction in the brain, to try to understand more of the complex chemical circuitry governing our response to tiredness.

More information: *Nature Neuroscience* DOI: 10.1038/nn.3957

Provided by Imperial College London