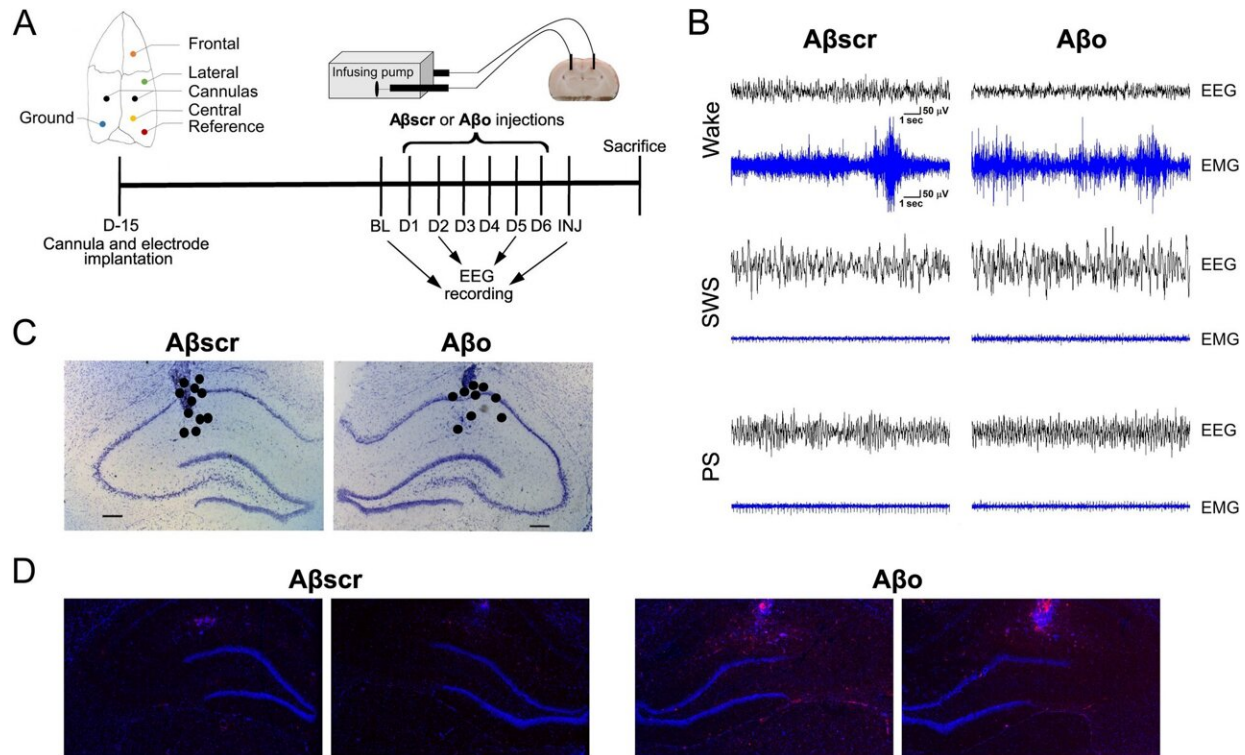


Decoding sleep to reveal our state of health

March 18 2024, by Bruno Geoffroy



A Schematic representation of the position of cannulas (in CA1) and electrodes (surface of the cerebral cortex) and timeline of the experimental protocol. B Representative EEG and EMG traces of the frontal-central bipolar signal obtained for wakefulness, SWS, and PS during the INJ day in one rat submitted to Aβscr injections and one to Aβo injections. C Approximate position of the cannulas in the hippocampus was determined using Nissl staining and marked with black dots. D IHC images of Aβ staining in the hippocampus shown with DAPI staining (blue) in four rats submitted to 6 days of Aβscr (left) or Aβo (right) injections. Credit: *Alzheimer's Research & Therapy* (2023). DOI: 10.1186/s13195-023-01316-4

Sleep takes up almost one third of our life, yet many of its secrets remain unexplained. To penetrate the mystery, neuroscientists are trying to decipher some of the mechanisms of this basic biological function, so key to good health.

One of those neuroscientists is a Canadian: Université de Montréal (UdeM) professor Valérie Mongrain, holder of the Canada Research Chair in Sleep Molecular Physiology.

Her current project examines a potential link between [sleep](#) and Alzheimer's disease.

With UdeM professor Jonathan Brouillette, Mongrain said she's "looking to identify biomarkers present at the onset of Alzheimer's disease, by examining the effects of amyloid-beta oligomers on neurons and sleep."

The scientific literature is clear: Amyloid-beta oligomers accumulate in the brain one to two decades before Alzheimer's disease is diagnosed, said Mongrain, who's also involved in the Québec Sleep Research Network.

These oligomers are involved in the loss of connections—synapses—between neurons, notably in the hippocampus. This region of the brain is involved in sleep control and contributes to the so-called explicit memory through which people consciously remember things.

"Some of the first clinical symptoms we see in patients are disruptions in wakefulness and sleep," said Mongrain. "But we don't know to what extent oligomers are responsible for these alterations."

Experiments on young rats

To find out, under her and Brouillette's supervision, doctoral student Audrey Hector conducted laboratory experiments on young male rats. She first injected soluble amyloid-beta oligomers into the rats' hippocampus, then took electroencephalographic (EEG) recordings, measuring their brains' electrical activity to see how the oligomers affect wakefulness and sleep amount and alternation.

In the subsequent [study](#) published last October in *Alzheimer's Research & Therapy*, the scientists not only reveal a change in the rats' [brain activity](#) during sleep and wakefulness, but also highlight the existence of an EEG "signature" specific to the pathology.

"Clearly, this signature could be used as a biomarker to identify individuals at risk of developing Alzheimer's disease, long before the disease is diagnosed," said Mongrain. "Monitoring brain activity for this signature could be used as a non-invasive diagnostic tool and enable earlier therapeutic interventions."

While conducting EEG recordings during sleep requires more resources, Mongrain hopes to find a signature robust enough to do the job much easier and faster—accomplishing it in little as a few minutes during the waking phase.

Some promising new collaborations

After just one year at the CHUM Research Center (CRCHUM), Mongrain has already begun promising collaborations with colleagues there, notably with the research teams of epilepsy specialists Élie Bou Assi and Dr. Dang Khoa Nguyen.

With EEG recordings taken during the sleep periods of people being monitored for epileptic disorders at the CHUM's epilepsy monitoring unit, the scientists are trying to determine whether sleep could be a good

predictor of future seizures.

"Using [artificial intelligence](#) tools Élie has developed, we're looking for EEG signatures or alterations in slow waves during sleep that would help us reliably predict the occurrence of a seizure, and warn a patient not to drive or go to work, for example," said Mongrain.

And her scientific enquiries don't stop there. In a separate project at the CRCHUM, she's also looking at how the biological clock is affected by light and darkness.

In humans, circadian rhythms adjust to the cycle of light and dark that pass through their retinas. With UdeM neuroscientist Adriana Di Polo, an expert in retinal physiology at the CRCHUM, Mongrain is exploring how [adhesion molecules](#) involved in sleep regulation affect the functioning of the retina and people's biological clock.

More information: Audrey Hector et al, Hippocampal injections of soluble amyloid-beta oligomers alter electroencephalographic activity during wake and slow-wave sleep in rats, *Alzheimer's Research & Therapy* (2023). [DOI: 10.1186/s13195-023-01316-4](https://doi.org/10.1186/s13195-023-01316-4)

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