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The circadian clock and neural circuits maintaining body fluid homeostasis

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WORLD WIDE NEURO PLATFORM

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MEETING ID & PASSCODE

None

SPEAKER

Charles Bourque, PhD

Professor, Department of Neurology-Neurosurgery, McGill University
Senior Research Scientist, Research Institute McGill University Health Centre

BIO

Dr. Bourque obtained a Certificate in Biophysics from the Marine Biological Laboratory in 1984 (Woods Hole, USA) and a Ph.D. in Physiology from McGill University in 1985 (Montreal). Following post-doctoral training in Pharmacology at the School of Pharmacy of University College London (UK) he was recruited to McGill University's Centre for Research in Neuroscience. Dr. Bourque has published >140 scientific papers, co-edited 1 book, and delivered >150 invited presentations at National and International venues.

The Bourque laboratory is investigating the molecular and cellular mechanisms by which the brain monitors body hydration, fluid electrolytes and core temperature. The team is particularly interested in defining how networks of thermosensitive and salt-sensitive neurons communicate with neurons in the central clock and other brain cells to preserve homeostasis by controlling the perception of thirst and secretion of the water conserving hormone vasopressin.

Life-threatening defects in body fluid balance are featured in many acute clinical conditions, including drug overdose, heart failure, sepsis and traumatic brain injury. Moreover changes in fluid balance likely link dietary salt intake to many forms of hypertension. The Bourque team is investigating how changes in neuronal properties and inter-neuronal communication contribute to such conditions.

Honors awarded to Dr. Bourque have included the Medical Research Council of Canada's Scholarship, Scientist and Senior Scientist awards, as well as a Senior Investigator award from the Canadian Institutes of Health Research. He has received the Joseph Erlanger Distinguished Lecturer Award from the American Physiological Society, the Jacques Benoit Lectureship from the Société de Neuroendocrinologie (France), the Stevenson Lectureship from Western University (Ontario) and a Distinguished Lectureship from the University of Saskatchewan. Dr. Bourque was inducted as a Fellow of the Royal Society of Canada in 2016 and the Canadian Academy of Health Sciences in 2019. He was President of the Canadian Association for Neuroscience (2020-2021).

RESEARCH

Neurons in the suprachiasmatic nucleus (SCN, the brain's master circadian clock) display a 24 hour cycle in the their rate of action potential discharge whereby firing rates are high during the light phase and lower during the dark phase. Although it is generally agreed that this cycle of activity is a key mediator of the clock's neural and humoral output, surprisingly little is known about how changes in clock electrical activity can mediate scheduled physiological changes at different times of day. Using opto- and chemogenetic approaches in mice we have shown that the onset of electrical activity in vasopressin releasing SCN neurons near Zeitgeber time 22 (ZT22) activates glutamatergic thirst-promoting neurons in the OVLT (organum vasculosum lamina terminalis) to promote water intake prior to sleep. This effect is mediated by activity-dependent release of vasopressin from the axon terminals of SCN neurons which acts as a neurotransmitter on OVLT neurons. More recently we found that the clock receives excitatory input from a different subset of sodium sensing neurons in the OVLT. Activation of these neurons by a systemic salt load delivered at ZT19 stimulated the electrical activity of SCN neurons which are normally silent at this time. Remarkably, this effect induced an acute reduction in non-shivering thermogenesis and body temperature, which is an adaptive response to the salt load. These findings provide information regarding the mechanisms by which the SCN promotes scheduled physiological rhythms and indicates that the clock's output circuitry can also be recruited to mediate an unscheduled homeostatic response.

OBJECTIVES

1. Gain an understanding of the contribution of vasopressin in control of arterial pressure and osmoregulation

2. Gain an understanding of the how neurons in the central circadian clock contribute to osmoregulation

3. Gain insight into how non photic signals can influence the circadian clock.

For more information:

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