Medical Xpress

Unexpected discovery reveals a new mechanism for how the cerebellum extracts signal from noise

March 21 2012

Research at the University of Calgary's Hotchkiss Brain Institute (HBI) has demonstrated the novel expression of an ion channel in Purkinje cells – specialized neurons in the cerebellum, the area of the brain responsible for movement. Ray W. Turner, PhD, Professor in the Department of Cell Biology & Anatomy and PhD student Jordan Engbers and colleagues published this finding in the January edition of the journal *Proceedings of the National Academy of Sciences* (*PNAS*).

This research identifies for the first time that an ion channel called KCa3.1 that was not previously believed to be expressed in the brain is actually present in Purkinje cells. In addition, these researchers demonstrate the mechanism by which this ion channel allows Purkinje cells to filter sensory input in order to coordinate the body's movements.

The discovery was unexpected, as Engbers explains, "we didn't specifically go looking for this channel. A lot of time was spent trying to identify the source for an electrical current that we were observing and we finally found ourselves asking 'what evidence is there that KCa3.1 isn't in the brain?' So we ran some tests and all the pieces really fell into place."

In the cerebellum, sensory input activates neurons called Purkinje cells that have to filter the information and respond only to relevant inputs to produce an appropriate movement response. Although this function of

Purkinje cells has been well documented, Engbers and Turner take our understanding a step further by demonstrating that the KCa3.1 ion channel plays a key part in this process - acting as a gatekeeper to filter the enormous amount of incoming information.

As Turner explains, "these cells receive hundreds of thousands of signals every second from the body's sensory systems. KCa3.1 then allows the cells to filter out the background noise and respond to only the three or four inputs that are particularly relevant".

Engbers further describes the mechanism by which KCa3.1 filters out the unwanted information, "these channels are activated by an influx of calcium, which generates an inhibitory influence until the correct input is detected. Once the appropriate input is detected, the Purkinje cell responds with a burst of nerve impulses, which in turn initiates the proper motor response."

This research fills a substantial gap in understanding how neurons in the cerebellum process information. Engbers and Turner expect that continued research will identify KCa3.1 in other areas of the brain and that it will be responsible for several still unexplained phenomena observed in neuronal recordings.

"What we have found will help us understand how the cerebellum functions normally. Now that we have shown the scientific community this new information, we expect that it will become clear that KCa3.1 plays a much wider role in brain function," says Engbers.

Provided by University of Calgary