Medical Xpress

Pair of proteins gets brain cells into shape

December 20 2012

Scientists at the German Center for Neurodegenerative Diseases in Bonn have gained new insights into the early phase of the brain's development. In cooperation with researchers of the Max Planck Institute of Neurobiology, the University of Bonn and other German and international colleagues they identified two proteins that control the formation of cell protuberances. The typical ramifications through which nerve cells receive and forward signals ultimately originate from these outgrowths.

The study conducted by Prof. Frank Bradke's team provides indications on brain development and about the causes of diseases of the nervous system. The results have now been published in *Neuron*.

Under the microscope, the brain appears as a network of intricate beauty comprising billions of nerve cells (the so-called "neurons") linked together. This network is engaged in a constant process of sharing information. The signals are transmitted from neuron to neuron through fine ramifications of the cell body. However, to acquire this typical structure, young nerve cells have first to go through a shape transformation. "Young neurons have a rather inconspicuous form. They tend to be round and are reminiscent of cherries," comments Frank Bradke, group leader at the DZNE in Bonn. "At this stage, the neuron is much like an island. It is insulated and does not have any direct contact with other cells."

Consequently, nerve cells have to go through a phase of change while they are still in the early stages of their development. To date, little was known about how the cells master this transformation, which is so important for their function. It is essential for the brain's development that its neurons develop contacts to a multitude of other cells. The initial step of this process is that tiny extensions, the so-called "neurites" protrude out of the cell body. The study conducted by the researchers in Bonn and their colleagues sheds light on this process.

A dynamic duo gets its grip on the cell's corset

Investigating mouse brain cells, the neuroscientists were able to identify the three key players involved in the shape change: the cell's cytoskeleton, which consists of specific proteins that give the cell its form and stability, as well as the two proteins named "ADF" and "cofilin." "We were able to show that these two proteins do have a significant impact on cell structure," explains Dr. Kevin Flynn, a postdoc researcher in Bradke's team and first author of the report published in "*Neuron*". "Much like scissors they cut through the support corset of the cell in the proper location. Neurites can subsequently develop through these gaps."

For this to occur several processes have to work hand in hand: along its perimeter, the neuron receives its stability mainly through a network of actin filaments, string shaped protein molecules. The proteins ADF and cofilin can alter this structure by dissolving the actin filaments and enabling fragments resulting from this process to be carried away. As a result, other components of the cytoskeleton – the microtubules – are able to come to action. The microtubule migrate through the newly opened gap and form a new cell protuberance.

Impact on the development of the brain

In their study, the researchers demonstrated the significance of the two proteins in nerve cell development. In certain mice, the production of ADF and cofilin was virtually halted. As a result the brains of newborn animals had severe abnormalities. Analysis of their brain cells indicated that they had failed to develop any neurites.

"Our study shows that the proteins ADF and cofilin, and their interaction with actin filaments, are key factors for brain development," comments Bradke. However, the development of neurites is also of relevance in other contexts. For instance, nerve cells have to regrow their connections after an injury. In addition, a number of diseases and malformations of the nervous system are linked to underdeveloped neurites. "We now have a better understanding of the molecular processes that are involved in this important process."

More information: "ADF/cofilin-mediated Actin Retrograde Flow Directs Neurite Formation in the Developing Brain," Kevin C. Flynn, Farida Hellal, Dorothee Neukirchen, Sonja Jacobs, Sabina Tahirovic, Sebastian Dupraz, Sina Stern, Boyan K. Garvalov, Christine Gurniak, Alisa Shaw, Liane Meyn, Roland Wedlich-Söldner, James R. Bamburg, J. Victor Small, Walter Witke, Frank Bradke, *Neuron*. www.cell.com/neuron/abstract/S0896-6273%2812%2900897-5

Provided by Helmholtz Association of German Research Centres

Citation: Pair of proteins gets brain cells into shape (2012, December 20) retrieved 10 April 2024 from https://medicalxpress.com/news/2012-12-pair-proteins-brain-cells.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.