Scientists discover cell surface 'docking stations' play important function in membrane protein trafficking

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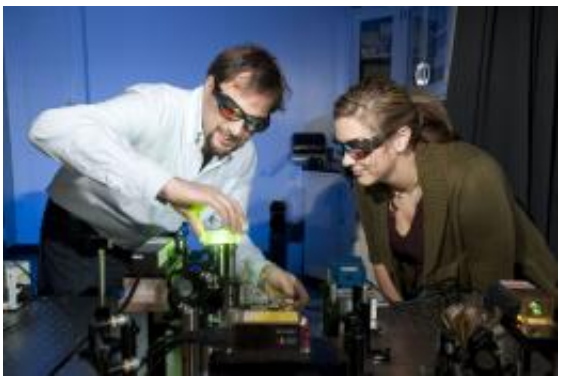

Diego Krapf and a student working in his laboratory

(Phys.org) -- Ion channel proteins – teeny batteries in cells that are the basis for all thought and muscle contraction, among other things – also serve as important docking stations for other proteins that need help figuring out where to go, according to groundbreaking new research by a team of Colorado State University scientists.

The research by Diego Krapf, an assistant professor in the Department of Electrical and Computer Engineering, and Mike Tamkun, a professor in the Department of Biomedical Sciences, appears this month in the peer-reviewed journal, *Molecular Biology of the Cell*. Co-author Emily Deutsch, who began working on this project as a freshman, obtained her

bachelor's degree in Biology from Colorado State in May.

Ultimately, the basic discovery could help scientists solve puzzles like how certain mutations in ion channel genes lead to epilepsy and other nerve diseases or cardiac diseases such as stroke and hypertension.

Ion channels are pores in the membranes of all neurons that regulate electrical activity and the passage of information in the nervous system. Interfering with those channels can disrupt this information flow. Lidocaine, for example, blocks ion channels that prevent the pain of dental work from getting to the brain. Another example that Tamkun uses in his classes: Capsaicin, the active ingredient in peppers that makes them hot, works by opening a specific ion channel in nerve cells designed to sense temperature. Those nerve cells connect to pain-sensing pathways, which is why some people feel pain when they eat peppers, he said.

Now Tamkun and Krapf have discovered that certain ion channels, in addition to being the overseers of electrical currents in cells, also serve as transportation hubs or docking stations for other cell surface proteins and help deliver those proteins where they need to go. Using single molecule detection techniques, they've captured on video ion channels forming platforms, attracting proteins and holding them within the platform like cows in a corral before sending them to their destination.

The scientists suggest that these platforms are critical to understanding strokes because, under a microscope, they visibly fall apart on nerve cell surfaces affected by stroke. So far, their studies have focused on one of 60 channels in the human body that deliver potassium, but they are also studying sodium and calcium channels.

"Mutations in ion channel genes cause both nerve and cardiac disease, and in many cases we don't know what these mutations do to the ion

transporting activity of the channel," Tamkun said. "So we wondered whether channels could be doing something other than passing electrical current. We figured out how to label the channels in living cells so we can take movies of them moving around using a high-powered microscope. The channels form specialized delivery platforms on the cell surface that signal where proteins need to be sent."

"We're interested in how ion channel proteins move on the cell surface, that includes how they get into the cell surface and how they're removed from the cell surface," Krapf said. "We decided years ago it would be a good idea if we could look at these molecules one molecule at a time – we didn't know much about how their movement could be analyzed.

"It's a new function for these channels – to form a platform to signal to the cell where other proteins need to be sent," Krapf said.

The interdisciplinary science is a mix of cell biology, optical imaging of cells and the analysis of the active and random motion of molecules. Krapf, a physicist, captures and analyzes random motion of molecules while Tamkun focuses on cell makeup and behavior.

"That's the way the major discoveries are likely to occur – when collaborations exist between scientists in different fields," Tamkun said.

More information: www.molbiolcell.org/content/ea … 1-0047.full.pdf+html

Provided by Colorado State University

https://phys.org/news/2012-06-scientists-cell-surface-docking-stations.html