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Researchers develop marker that identifies energy-producing centers in nerve cells

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A protein that causes coral to glow is helping researchers at the University of Maryland School of Medicine to light up brain cells that are critical for the proper functioning of the central nervous system. This fluorescent marker protein may shed light on brain cell defects believed to play a role in various neurological diseases. The researchers describe how this marker works in mice in the December 20, 2006, issue of *The Journal of Neuroscience*.

The marker gives scientists the first-ever opportunity to distinguish between energy-producing structures, called mitochondria, in neurons, from mitochondria in other brain cells, called glia. Defects in mitochondria may be part of the process that leads to Alzheimer's and Parkinson's disease, as well as changes in the brain associated with stroke and aging.

"Prior to the development of this marker, we had no way to identify the mitochondria in neuronal cells from those in glial cells," says the study's principal investigator, Krish Chandrasekaran, Ph.D., an assistant professor in the Department of Anesthesiology at the University of Maryland School of Medicine. "Using this tool, we and other investigators can answer certain questions, such as to what extent does neuronal mitochondrial dysfunction contribute to Parkinson's or Alzheimer's. And, in a general way, we could look into whether there are changes in neuronal mitochondria as we age."

Using advanced genetic techniques, the researchers have produced mice

with fluorescent protein markers that identify only the mitochondria in neurons. These structures light up with a greenish-yellow glow when the scientists look at the brains of these mice through a fluorescent microscope. The researchers have determined that the expression of the fluorescent protein does not interfere with the normal functions of mitochondria.

Neurons conduct and generate electro-chemical impulses or nerve signals, which carry information from one part of the brain to another. Mitochondria in the neurons function like cellular powerhouses to produce those impulses through a metabolic process that combines oxygen with food calories. It is these nerve signals that cause muscles to move and thoughts to be processed. Dr. Chandrasekaran says the fluorescent marker system may make it possible to explore how neuronal activity and the mitochondrial energy-producing system are coordinated and how the interrelationship works.

The researchers say the establishment of the fluorescent marker in mice could unravel the mysteries of some of the most debilitating neurodegenerative diseases. The study's senior author, Tibor Kristian, Ph.D., an assistant professor in the Department of Anesthesiology at the University of Maryland School of Medicine, says there are animal models for several of these diseases including Parkinson's, Alzheimer's, amyotrophic lateral sclerosis (also known as ALS) and Huntington's disease. "The mice we have developed with the fluorescent protein could be bred with mouse models of various neurological diseases, so we could apply the ability to see mitochondria in neurons to the research of those diseases," says Dr. Kristian.

This mouse model could also be used to study the role of neuronal mitochondria in stroke and traumatic brain injury, according to Dr. Kristian. He says his investigators are developing a similar marker for glial cells in the brain.

Source: University of Maryland Medical Center