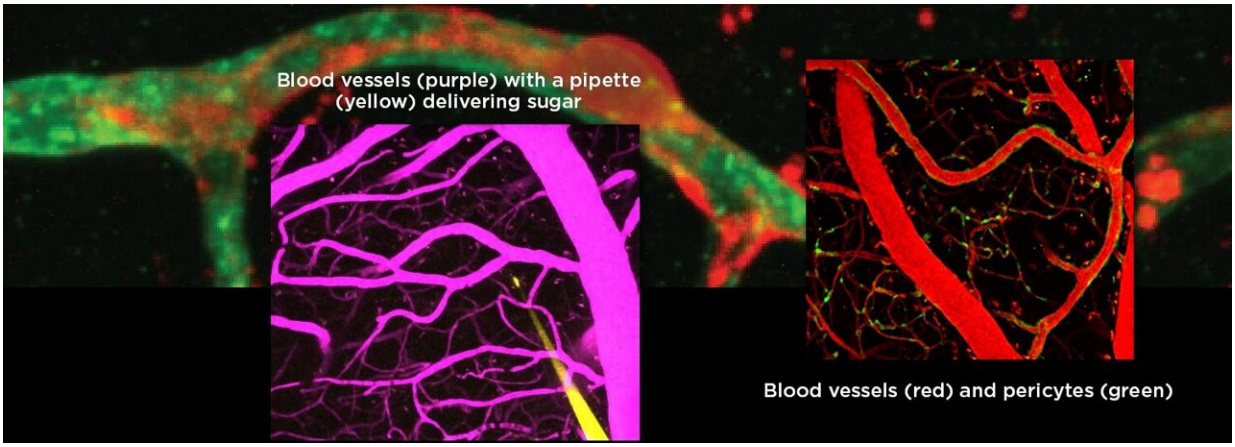
Special vascular cells adjust blood flow in brain capillaries based on local energy needs

January 25 2023, by Vanessa McMains



Pericytes on the brain's capillaries sense sugar and when levels are low they signal for blood vessels to dilate. Credit: UMSOM

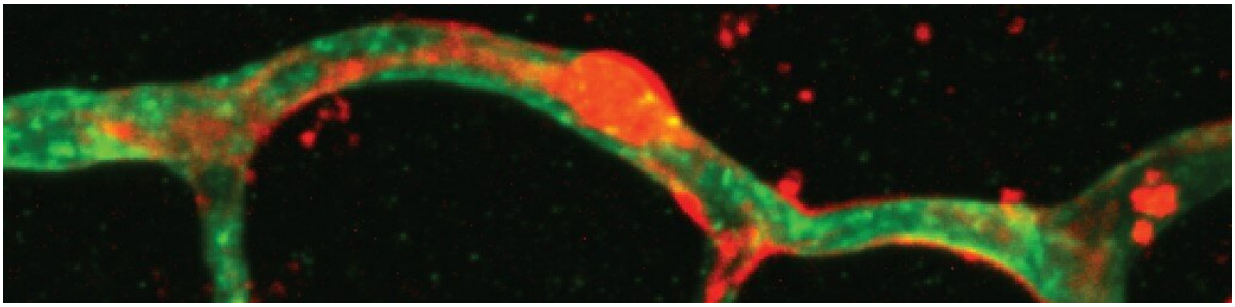
When we smell hot dogs, it may trigger memories of backyard barbeques or attending baseball games during childhood. During this process, the areas of the brain that control smell and long-term memory are rapidly firing off impulses. To fuel these signals from neurons, the active brain regions need oxygen and energy in the form of blood sugar glucose, which is quickly delivered through blood vessels.

Now, University of Maryland School of Medicine's researchers have discovered that a certain type of cell that sits on top of the brain's smallest blood vessels senses when their brain region needs energy.

When glucose levels are low, these cells signal blood vessels to dilate, increasing the blood flow regionally and allowing more energy to fuel that part of the brain.

These findings from experiments in mice were published on Dec. 27, 2022, in *Cell Reports*.

"These fluctuations in blood flow help direct the brain's energy resources to support everyday functions," said study leader Thomas Longden, Ph.D., Assistant Professor of Physiology at UMSOM. "As I am speaking now, the blood flow in my brain will be diverted to the language areas and the motor (or movement) areas that control my vocal cords to fuel these processes."

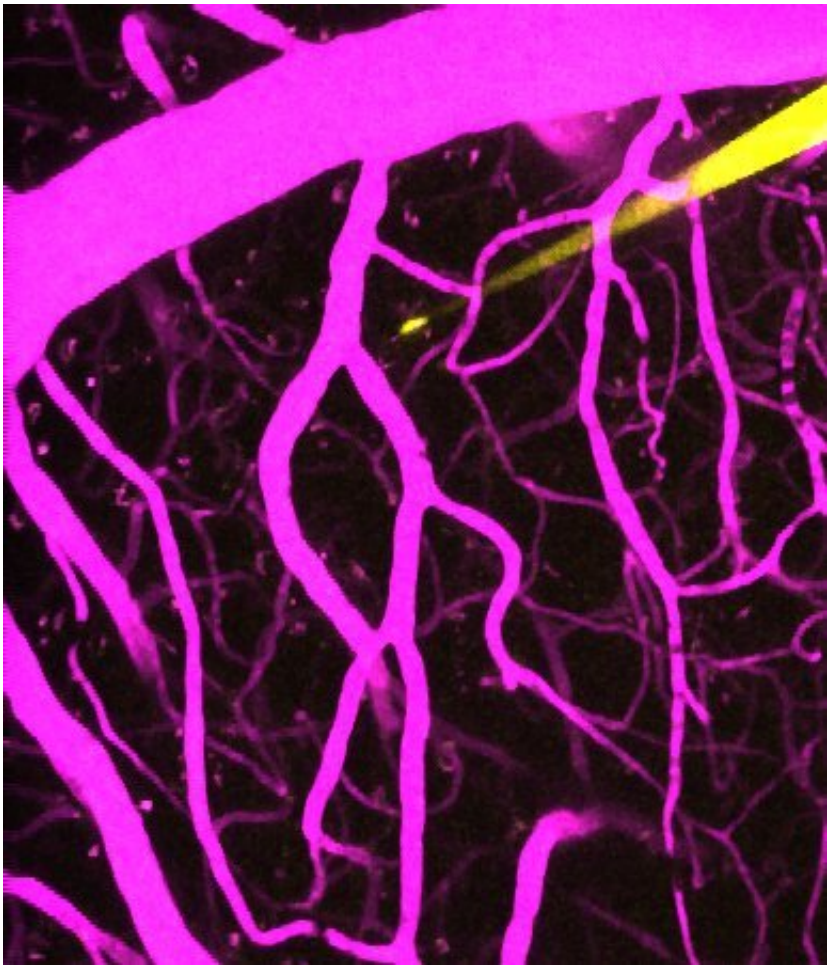


Pericyte (red) atop a capillary. Credit: Longden Lab

In 2022, Dr. Longden's laboratory showed that signals in the form of calcium—shaped by electrical impulses through the blood vessels—cause certain brain capillaries to relax controlling blood flow, through a paper published in *Science Advances*. In their newest study, his team demonstrated that a specific type of cell located along the outside of the capillaries, known as pericytes, direct these electrical pulses based

on their perception of local energy needs.

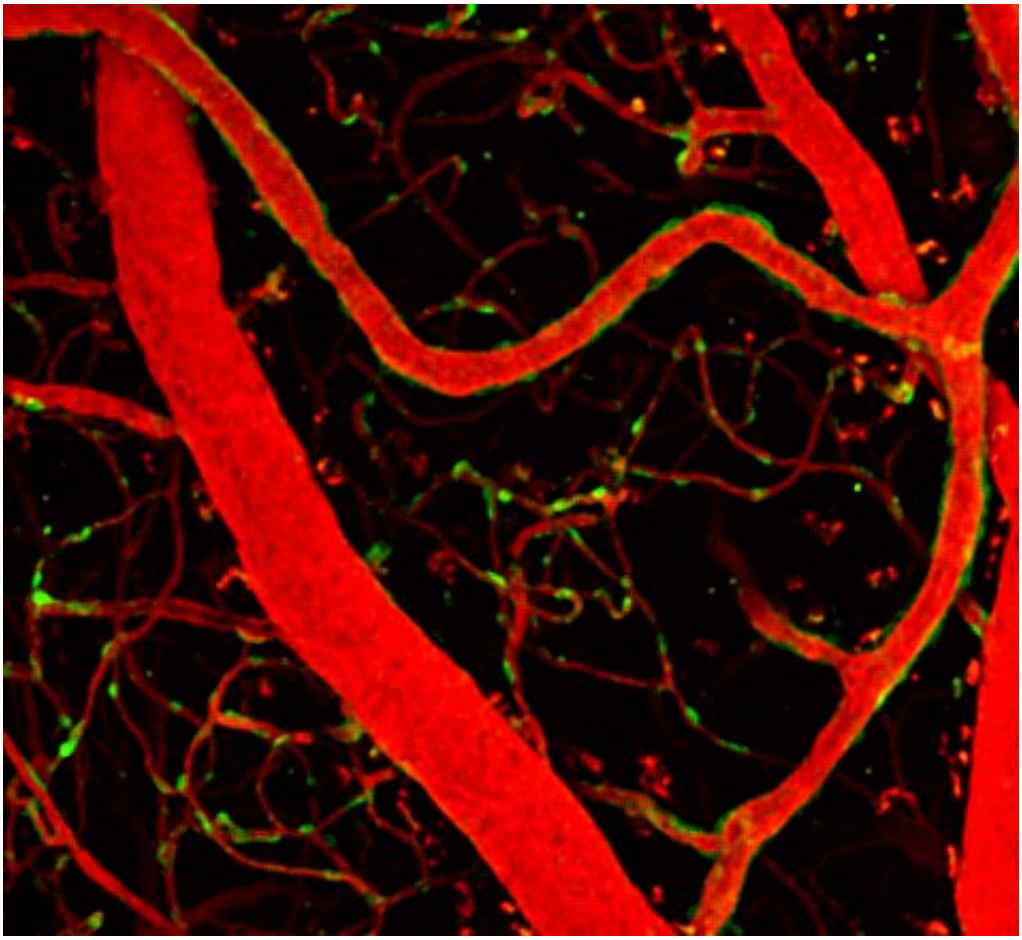
The researchers directly observed this process playing out in mouse brains using advanced microscopy, and then dissected out the capillaries with their attached pericytes. They then measured electrical signals given off by the pericytes when glucose levels were adjusted. They found that the pericytes rapidly generated electrical signals when the sugar levels were low, but not when the levels were high.



Blood vessels (purple) with a pipette (yellow) delivering sugar. Credit: Longden Lab

"If adequate energy is not supplied by the brain blood vessels to the neurons in a timely manner, there can be a mismatch of energy supply and demand. This causes the brain's neurons to undergo stress, which can lead to impaired protein metabolism, changes in how the neurons fire, and even eventually cell death," said study co-author Ashwini Hariharan, Ph.D., Postdoctoral Fellow in Physiology at UMSOM.

"This energetic failure in blood vessel function of the brain has been shown to occur during the aging process, in certain neurodegenerative diseases, like Alzheimer's, and in stroke," said Dean of UMSOM Mark T. Gladwin, MD, Vice President for Medical Affairs, University of Maryland, Baltimore, and the John Z. and Akiko K. Bowers Distinguished Professor.



Blood vessels (red) and pericytes (green). Credit: Longden Lab

Dr. Longden added, "By studying how this process functions normally, researchers may be able to gain further insight into what happens in aging or in neurodegenerative diseases, so they can develop better therapies."

More information: Ashwini Hariharan et al, Brain capillary pericytes are metabolic sentinels that control blood flow through a KATP channel-dependent energy switch, *Cell Reports* (2022). DOI: 10.1016/j.celrep.2022.111872

Provided by University of Maryland School of Medicine