Brain blood flow sensor discovery could aid treatments for high blood pressure and dementia

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A study led by researchers at UCL has discovered the mechanism that allows the brain to monitor its own blood supply, a finding in rats which

may help to find new treatments for human conditions including hypertension (high blood pressure) and dementia.

For decades, scientists have suspected that the brain had a way of monitoring and regulating its own blood flow separate from the body-wide blood pressure control system, but until now no one had proven this.

The brain needs more blood than any other organ to satisfy neurons' relentless, high demand for oxygen, so it makes sense that it would have a way of buffering itself from blood flow fluctuations in the wider body. Disturbances to brain blood flow are a known cause in many diseases—for example, sustained reduction in brain blood flow is a likely cause of cognitive decline, dementia, and neurodegenerative disease such as Alzheimer's disease.

In a study published in *Nature Communications*, researchers from UCL, the University of Auckland and Bristol University, found a new function for the star-shaped brain glial cells, known as astrocytes. These cells function as specialised brain blood flow sensors that operate to self-protect the brain from potentially damaging reductions in blood supply.

Astrocytes are strategically positioned between the brain blood vessels and important nerve cells, which control the heart and peripheral circulation, ultimately determining the arterial blood pressure.

In the laboratory-based study in rats, the researchers found that decreases in brain blood flow caused astrocytes to release a chemical signal, which stimulated the specialised nerve cells to increase blood pressure and restore/maintain blood flow (and oxygen supply) to the brain.

Professor Alexander Gourine (UCL Division of Biosciences), who led

the study, said: "We are very excited about this observation: there has never been a formal description of a blood flow or blood pressure sensor within the brain before.

"Our new data identify astrocytes as brain blood flow sensors that are critically important for setting the level of systemic (arterial) blood pressure and in doing so ensure that the brain receives a sufficient amount of oxygen and nutrients to support the uninterrupted operation of the information processing machinery."

Co-author Professor Julian Paton, (University of Auckland), said: "These astrocyte cells are exquisitely sensitive to reductions in brain blood flow. When blood supply is reduced, they release a chemical signal to nearby nerve cells that raise blood pressure, restoring blood flow to the brain. What we have discovered is that the brain has an automatic way to make sure that brain blood flow is preserved.

"Unfortunately, in pathological conditions this is happening at the expense of generating higher blood pressure in the rest of the body. This suggests that increasing brain blood flow by reducing activity in these blood flow sensing astrocytes may be a way to lower blood pressure in people with hypertension. It may also be a way to combat migraines and strokes. On the other hand, sensitising these cells may help in conditions of dementia to improve brain blood flow."

Corresponding author, Dr. Nephtali Marina-Gonzalez, (UCL Division of Medicine), said: "In disease situations where blood supply to the brain is reduced, the mechanisms we describe can over-react causing migraines, high blood pressure and strokes. The identity of the brain blood flow sensor will make it possible to search for novel targeted treatment strategies to alleviate these diseases".

More information: Nephtali Marina et al, Astrocytes monitor cerebral

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perfusion and control systemic circulation to maintain brain blood flow, *Nature Communications* (2020). DOI: 10.1038/s41467-019-13956-y

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