Lactic acid protects the brain

Lactic acid has had a bad reputation for a long time. Now researchers have discovered that it in fact protects your brain.

Lactic acid is normally associated with stiff muscles. Now researchers have demonstrated that lactic acid in fact protects the white matter in the brain.

The brain’s white matter is mainly comprised of nerve tracts which connect the various parts of the brain together and lead the nerve signals up and down the spinal cord. The electric signals travel rapidly through the myelin – the protective fatty sheath around the nerve fibres.

By examining brain slices from mice, a group of Norwegian and British researchers have found that physiological concentrations of sugar is not enough to keep the oligodendrocytes - the myelin-forming cells - alive. But, addition of lactic acid to the brain slices enabled the cells to survive, and the myelin remained intact.

Protects regardless of conditions

“We let the brain cells grow but in differing concentrations of sugar and lactic acid. After two weeks we observed that the brain slices that had physiological concentrations of sugar did not have normal myelin formation unless they also had lactic acid”, explains post doctorate Johanne Egge Rinholm at the Institute of Basic Medical Sciences, University of Oslo.

This finding, which is the result of a two-year research collaboration between researchers from the University of Oslo and researchers from University College London, thus demonstrates that lactic acid has a protective function on the brain, not only under normal conditions but also when blood sugar is too low.

Proving the “impossible”

Up until now it has been almost impossible to demonstrate the significance of lactic acid in myelin formation.

“The nerve fibres and myelin lie so close together that normally it is not possible to see whether the lactic acid has been taken up in the nerve fibres or in the myelin. The effect of lactic acid could have been expressed through an indirect action. This has now been disproved,” comments Rinholm.

She filled individual myelin-forming cells with a stain that changes colour if lactic acid is taken up by the cell. When lactic acid was added, the stain could be seen to change colour.

“Because only the myelin-forming cells and not the nerve fibres were filled with the stain, I knew that the colour change was due to lactic acid being taken up by the myelin-forming cells,” explains Rinholm and continues:

“Previously we believed that lactic acid only benefited the nerve cells, but this work demonstrates that it is...
just as important for the myelin-forming cells."

**Can prevent damage resulting from disease**

Knowledge on oligodendrocyte sensitivity and protection by lactic acid means that we can improve future treatment for people who have suffered diminished blood flow to parts of the brain. Often, the white matter suffers severe damage in patients with cerebral paresis or stroke. This is because these parts of the brain for a time do not get enough blood.

In Norway, about 8,000 Norwegians have cerebral paresis, and each year between 14,000-15,000 Norwegians suffer a stroke.

“We know that a number of events that result in lack of blood to parts of the brain can damage the white matter because lack of blood prevents normal myelin formation or kills the myelin that is present. Our present findings can perhaps contribute to making it easier to prevent damage to the white matter,” explains Rinholm.

**More unsolved myelin riddles**

In December, Rinholm was one of four researchers awarded a postdoctoral scholarship from the Research Council of Norway. The scholarship will be used for further studies on myelin.

“I will continue to study which energy substrates – such as sugar and lactic acid – that the myelin-forming cells use to make myelin and to keep healthy,” she comments.

Rinholm will also investigate how various organelles such as mitochondria help to convert the energy substrates to myelin and other substances that the cell can use to stay healthy.

“We already know a lot about this, but we don’t for example know why myelin-forming cells need higher concentrations of sugar and lactic acid than nerve cells to stay healthy. By gaining a better understanding of how these cells function may, for example, enable us in the future to prevent the damage that occurs to myelin during a stroke,” says Rinholm.

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Read the article in Norwegian at forskning.no [6]

The image to the left shows that brain slices from mouse grown in physiological concentrations of sugar had an unnormal small amount of myelin (red-pink colour). The right side image shows that when adding lactic acid the amount of myelin increased to a normal level. (Photo: Johanne E. Rinholm.) [7]

glukose-melkesyre-300.jpg [8]

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January 15, 2012 - 05:00