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Press release

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Reducing vitamin B5 slows breast cancer growth

Scientists have discovered in animal experiments that breast cancer cells heavily rely on vitamin B5 to grow and survive / Publication in 'Nature Metabolism'

In mice suffering from breast cancer, a lower intake of vitamin B5 can slow tumour growth. This was found by researchers from the University of Cologne's CECAD Cluster of Excellence for Aging Research and the British Francis Crick Institute, the British National Physical Laboratory (NPL) and Imperial College London. In their study, the team investigated the metabolic effects of one of the major cancer-driving genes called Myc. In tumour cells where Myc is highly expressed, it disturbs normal processes, drives cell growth and also makes tumour cells dependent on certain nutrients like vitamin B5. Vitamin B5 is also known as pantothenic acid and is found particularly in whole grain products, legumes, eggs, nuts and mushrooms. These dependencies could be exploited as potential therapeutic targets in the future. The study 'Vitamin B5 supports MYC oncogenic metabolism and tumour progression in breast cancer' was published in the journal 'Nature Metabolism'.

Since it is difficult to adequately identify and target metabolic dependencies in human tumours as Myc expression in the tumour can vary greatly, the researchers designed a simplified tumour model in which there are exactly two cell types: Myc-high areas glow green while Myc-low areas glow red. This clear division allowed for the first time to investigate the metabolism of different tumour cell types within the same tumour. By using a technique called mass spectrometry imaging, the researchers found that vitamin B5 was associated with Myc-high areas. This association was subsequently observed both in mice with transplanted human tumours and in primary biopsies taken from patients with breast cancer.

Vitamin B5 stimulates cancer growth

The scientists then set out to find the underlying mechanism that leads to Vitamin B5 accumulation in Myc high areas specifically. They could show that if cells have a lot of Myc, the amount of a multivitamin transporter increases, which consequently allows more vitamin B5 to enter the cells. When the researchers forced tumour cells to produce more molecules which make up this transporter, more vitamin B5 entered the cells – even in Myc-low cells. This manipulation alone was enough to enable faster growth of these cells, similar to what Myc would normally do.

Conversely, when they fed mice with a vitamin B5-deficient diet, the scientists found that their tumours, which had a mixture of Myc-low and Myc-high tumour cells, grew more slowly than tumours in mice fed with a standard diet. Normally, Myc-high cells grow faster than Myc-low cells, but without vitamin B5, they lost any growth advantage, and both cell types grew equally slower. The same happened in human breast cancer tissue when transplanted into the mice.

The team believes that this association with tumour growth is due to the key role that vitamin B5 plays in metabolism. Once absorbed into the cells, it is converted into a molecule called coenzyme A, which can be used in many metabolic pathways. This leads to the generation of more energy and to the production of substances such as fats, proteins and

carbohydrates, which allow the cell to grow.

Although the study links vitamin B5 to tumour growth, it would be too easy to simply restrict vitamin B5 intake for people with cancer – because vitamins are also important for the immune system to fight the tumour. The researchers are now developing strategies to specifically weaken the tumours without affecting the immune system, in order to increase the likelihood of a favourable clinical outcome for the patients.

Dr Peter Kreuzaler, group leader at the University of Cologne's CECAD Cluster of Excellence for Aging Research and former postdoctoral researcher in the Oncogenes and Tumour Metabolism Laboratory lead by Dr Mariia Yuneva at the Francis Crick Institute, said: "Previously, tumour metabolism was measured in bulk and could not provide too much insight into how areas of tumours use molecules like vitamins differently. By using a specialized high-resolution imaging technique in this study, we could see how metabolism differs across a tumour, and that removing just one vitamin stops a cascade of cancer-driving events." But that is still not the full picture, Kreuzaler said: "The mice used in this study had a weakened immune system, so the next steps are to observe the impact of removing vitamin B5 within a strong immune system."

Tracking vitamin B5 level could also be used as a biomarker to help researchers and doctors understand the genetic composition of a tumour in a human. In collaboration with King's College London, the team also develops indicator molecules – so-called tracers – for vitamin B5. These could be used to identify patients who are more likely to respond to Myc-specific treatments in clinical trials.

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