Branching for food: How nutrients remodel the fly circulatory system

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(Phys.org) —New research from the MRC Clinical Sciences Centre suggests that nutrients in the diet may play a role in changing the architecture of blood vessels in the gut and other organs. The study, in fruit flies, found that small changes in their diet alter the nerve signalling guiding branching of new oxygen-delivering tubules – a process reminiscent of adaptive angiogenesis. In turn, this affects how the fly handles and stores different nutrients from its diet.

It is not yet clear whether a similar process takes place in humans or other mammals, but if it does it might mean that this mechanism could be targeted as a way of modifying how organs store nutrients and fat. It also opens up the possibility that diet influences the arrangement of blood vessels in mammals, contributing to conditions such as obesity (and the improvements seen after gastric bypass), cancer or to the way the body adapts to malnutrition.

Adaptive angiogenesis is a process by which the structure of blood vessels surrounding a tissue or organ changes in response to demand for nutrients and oxygen. For example in certain cancers, tumours send out signals that create new blood vessels to deliver the oxygen and nutrients they need to grow. Although the control of this process is not fully understood, the prevailing view has been that signals from the target organ – that requiring the blood supply – underlie this process.

Here scientists have identified an alternative mechanism in the fruit fly that might be controlled by nutrients consumed in the diet. The model is the Drosophila's tracheal system – a network of tubes that deliver oxygen, akin to mammalian blood vessels.

This mechanism appears particularly prominent in the intestine where it drives, rather than responds to, metabolic change. The remodelling is controlled by distinct subsets of nerves that respond to oxygen and nutrients, which sculpt the tracheal system through delivering molecules called insulin-like and VIP-like peptides. These molecules are conserved across species, including humans.

Dr Irene Miguel-Aliaga from the MRC Clinical Sciences Centre, who led the research, said, "The vasculature of the fruit fly is far more active than we previously thought. It doesn't only listen to the target tissue, it listens to the nervous system. The implication is that we could target either the neurons or their vascular targets genetically, pharmacologically or otherwise to regulate how these organs are storing nutrients.

"However, we don't know yet what the relevance of these findings is to humans. We've found it in flies because we can turn genes on and off in small groups of neurons and/or oxygen-delivering cells. In humans, we would first need to find out whether, at the anatomical level, there is correlative evidence of gut vasculature changing in response to poor or imbalanced diets, or for example following gastric-bypass operations. If we find evidence for such changes we could then try to establish whether these are causative or not."

More information: "Neuronal Control of Metabolism through Nutrient-Dependent Modulation of Tracheal Branching." Gerit A. Linneweber, Jake Jacobson, Karl Emanuel Busch, Bruno Hudry, Christo P. Christov, Dirk Dormann, Michaela Yuan, Tomoki Otani, Elisabeth Knust, Mario de Bono, Irene Miguel-Aliaga. *Cell* - 16 January 2014 (Vol. 156, Issue 1, pp. 69-83). DOI: 10.1016/j.cell.2013.12.008

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