Scientists find missing link between brain activity and blood flow

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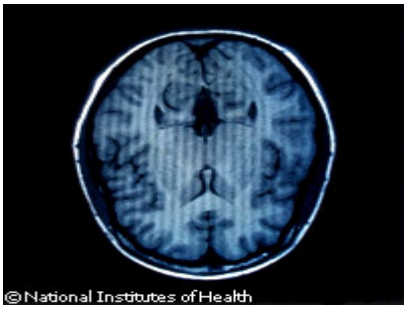

Researchers have worked out how neural activity boosts blood flow to the brain. The discovery promises to improve our understanding of the many brain imaging techniques which use blood flow in the brain as a proxy for neural activity. It could also shed light on the role of impaired blood flow to the brain in neurodegenerative diseases such as Alzheimer's.

The work, which was partly funded by the EU, is published in the latest edition of the journal Neuron.

Although the brain makes up just 5% of our body mass, it is responsible for 20% of our oxygen consumption. Unlike muscles and other tissues, the brain does not have internal energy stores. Instead the brain obtains oxygen and energy directly from the blood; when a region of the brain becomes active, the blood flow to that part of the brain increases, to provide the oxygen and energy required to support the increased activity.

Brain imaging techniques such as functional magnetic resonance imaging (fMRI) take advantage of this close link between blood flow and brain activity. Nevertheless, until now, the mechanisms by which the brain regulates this relationship have remained unclear.

'When you see a brain image from fMRI studies, you are actually looking at changes

in blood flow and oxygenation,' explained Venkatesh N Murthy of Harvard University, one of the authors of the study. 'But because of the tight coupling between neural activity and blood flow, we are able to use the blood flow changes as a surrogate for brain activity. A better understanding of exactly how brain activity boosts blood flow should help us better read this process in reverse, which is what we do when interpreting fMRI images.'

In this latest study, neuroscientists studied a part of the brain called the olfactory bulb, which processes scents and smells, in mice. 'When a mouse encounters a scent, discrete loci in its olfactory bulb are activated, which in turn increases blood flow in those spots,' said Professor Murthy. 'We measured all this using sophisticated optical microscopy, actually counting the number and rate of red blood cells passing through capillaries in the area.'

The scientists found that cells called astrocytes are the 'middle men' responsible for ensuring that blood flow to the different parts of the brain matches activity levels.

When a region of the brain becomes active, it releases molecules called neurotransmitters. When the astrocytes detect these, they cause the blood vessels to dilate, effectively increasing blood flow to that part of the brain. According to the researchers, many different molecular signalling pathways are involved in this process.

As well as increasing our understanding of brain imaging techniques, the findings could also prove useful to those studying neurodegenerative conditions such as Alzheimer's disease, and the ageing brain. Research shows that as people age or develop neurodegenerative diseases, the ability of the brain to match blood flow to activity levels may be impaired. Whether or not this causes some of the symptoms of cognitive decline remains a mystery.

The next step for the scientists is to examine whether their findings in the olfactory bulb also apply to the rest of the brain.

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