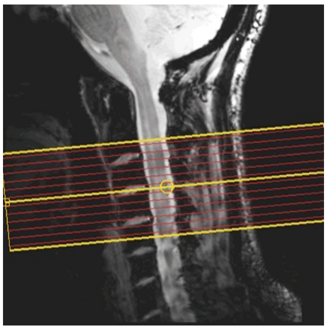
fMRI Detects and Characterises Resting State Signals



Researchers at Vanderbilt University's Institute of Imaging Science have achieved the first validated non-invasive measurement of neural signalling in the spinal cords of healthy human volunteers. This new imaging technology can play a role in helping patients to recover from spinal cord injuries and other disorders that affect spinal cord function, such as multiple sclerosis.

The findings of the study have been published in the journal eLife. The study was directed by senior author John Gore, PhD, a Professor of Medicine, University Professor and Vice Chair of Research in the Department of Radiology and Radiological Sciences; Robert Barry, PhD, a postdoctoral research fellow at Vanderbilt University and the study's first author; and co-workers Seth Smith and Adrienne Dula.

The researchers used ultrahigh-field functional magnetic resonance imaging (fMRI) in order to detect the resting state signals between neural circuits in the human spinal column. This is the first time this has been done. These specific signals always remain active: even when we are at rest, the spinal cord shows spontaneous but well organised fluctuations of activity. The resting state signals also account for most of the energy that is consumed by the brain. The research team reports that resting state signals can be seen in the spinal cord and are actually the hallmark of the entire central nervous system. According to Dr. Gore, “We see these background resting circuits as being inherent measures of function.”

fMRI measures neuronal activity indirectly by detecting changes in blood flow. It is a non-invasive imaging technique. fMRI can help provide greater insight into how spinal cord injuries alter the functional connectivity between neural circuits and also for evaluating and tracking recovery that occurs spontaneously or following various interventions.

This new imaging technique can prove to be very useful, since the spinal cord has always been more complicated to study given its very small size (around 12mm in diameter). Performing fMRI of the spinal cord can thus be very challenging. In addition, there are various sources of noise that can also degrade the quality of the signal. Traditional fMRI is not sensitive enough to capture its signals, but the Vanderbilt research team has been able to overcome this hurdle. They used an fMRI scanner with a 7 Tesla magnet, multichannel spinal cord coils and cutting-edge technology for acquiring and analysing the images.

The research team has now presented the first conclusive demonstration that ultra-high field fMRI can non-invasively detect and characterise resting state signals within the human spinal cord. To date, fMRI studies have targeted subjects with multiple sclerosis and spinal cord injury. However, the researchers propose that non-invasive methods of resting state spinal cord functional connectivity can be used to investigate damage due to acute or chronic spinal cord injury and for monitoring the efficacy of surgical or pharmacological interventions.

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