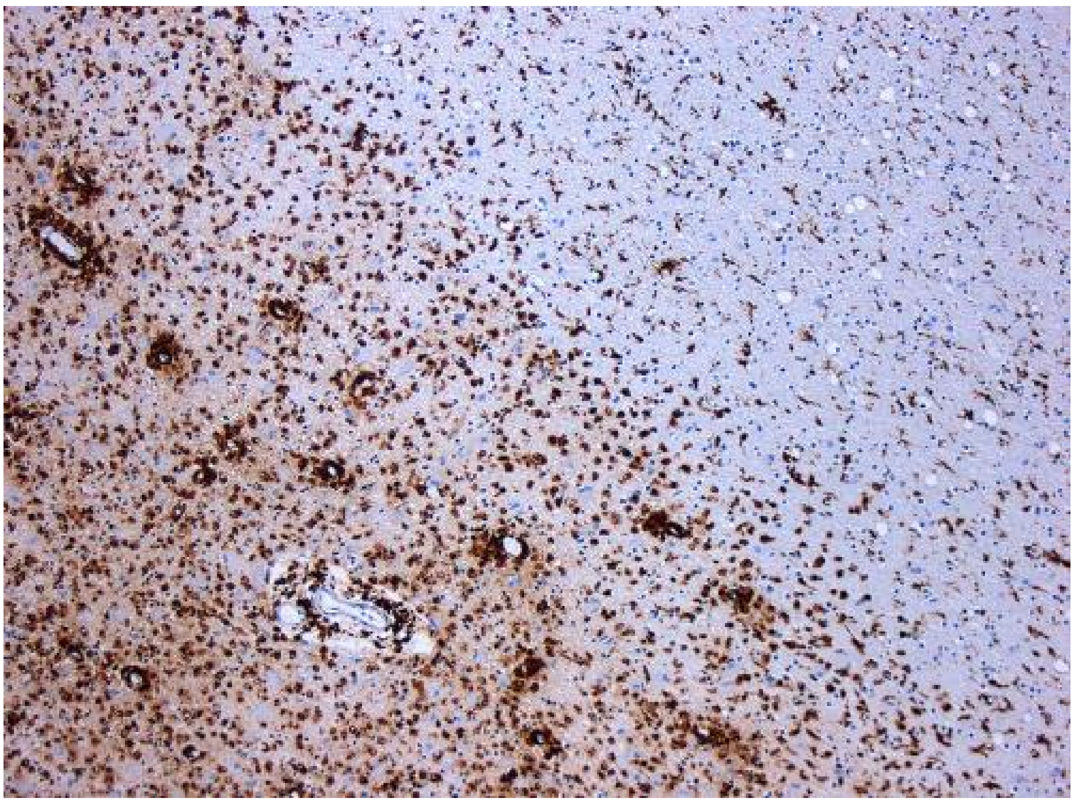
MRI technique detects spinal cord changes in MS patients

April 20 2018, by Bill Snyder



Demyelination by MS. The CD68 colored tissue shows several macrophages in the area of the lesion. Original scale 1:100. Credit: CC BY-SA 3.0 Marvin 101/Wikipedia

A Vanderbilt University Medical Center-led research team has shown that magnetic resonance imaging (MRI) can detect changes in resting-state spinal cord function in patients with multiple sclerosis (MS).

This first application of these measures in patients living with MS, reported last week in the journal *Brain*, could lead to new ways to monitor the effectiveness of drug treatment and physical therapy in slowing or stopping the progression of this chronic and often debilitating disease.

The paper, in effect, has opened the scientific conversation about spinal cord function in disease, said Seth Smith, Ph.D., director of the Human Imaging Core in the Vanderbilt University Institute of Imaging Science (VUIIS) and the paper's senior author.

"It is hard to imagine, but non-invasive assessment of the spinal cord at rest in MS was thought to be challenging, if not impossible," Smith said. "Now we turn it over to the greater scientific community to make this grow into an impact that could change patients' lives."

Multiple sclerosis (MS) is a chronic, inflammatory and ultimately progressive disease that attacks the central nervous system including the brain, spinal cord and optic nerves. More than 400,000 people in the United States are affected. Symptoms include weakness, dizziness and numbness, vision problems and loss of muscle coordination.

"The single biggest problem with MS is that we don't know when it starts," Smith said. "It's hard to catch it at its earliest stages."

VUIIS colleagues including institute director John Gore, Ph.D., have pioneered MRI techniques for detecting resting-state "functional connectivity" among different networks of nerve cells in the spinal cord.

They applied a technique called BOLD contrast imaging, which detects signal fluctuations based on the magnetic properties of blood hemoglobin as it transports oxygen to the brain and spinal cord, to study the "resting" spinal cord, when the brain has not tasked it to move the legs, for example.

This has been a challenge because the spinal cord is tiny, only about a half-inch in diameter, and because adjacent movements by the lungs, chest muscles and blood pulsing through the carotid arteries in the neck can obscure spinal cord signals.

In 2014, a Vanderbilt team led by Gore, Smith and Robert Barry, Ph.D., showed for the first time that they could detect signals from interconnected neural networks in the spinal cords of in healthy volunteers using an ultra-high field (7 tesla) MRI scanner.

Barry, now at the Athinoula A. Martinos Center for Biomedical Imaging at Massachusetts General Hospital in Boston, helped pioneer the acquisition and design the current study, which was led by Benjamin Conrad, a Neuroscience graduate student and the paper's first author.

The study showed that the 7-tesla technique could pick up slight differences in functional connectivity in the spinal cords of 22 patients with a relapsing-remitting form of MS compared to healthy controls. Differences were most pronounced in regions of patients' spinal cords that had visible lesions.

A lesion in the spinal cord presumably will cause some neurological damage. But this is the first time researchers have been able to noninvasively demonstrate that the presence of a lesion is correlated with altered neurological activity in the spinal cord.

These findings suggest that the technique might be used to determine whether medications, physical therapy or other interventions are preserving neurological function and thus slowing the course of the disease.

Few medical centers have access to a 7-tesla scanner. Conventional MRI scanners generate a magnetic field strength in the range of 3 tesla.

Recently Barry, Conrad and their coauthor, Satoshi Maki, MD, Ph.D., showed that it is possible to obtain high-quality measures of functional connectivity from the spinal cords of healthy volunteers using a 3-tesla scanner.

The Vanderbilt scientists are applying for a National Institutes of Health grant to do the same study at clinically relevant MRI field strengths in patients with MS, and recently won an NIH award to study spinal cord functional changes in patients with compressive myelopathy, compression of the spinal cord.

If the findings continue to hold up in larger and more diverse patient groups, "this technique could be deployed in a rural clinic in West Virginia just as easily as in an advanced medical center, and thus be able to reach a significantly larger population" Smith said.

It also could be useful in monitoring rehabilitation from spinal cord injuries or evaluating the functional effects of stem cell therapies for repairing nerves damaged by ALS (Lou Gehrig's disease), Conrad added.

More information: Benjamin N Conrad et al. Multiple sclerosis lesions affect intrinsic functional connectivity of the spinal cord, *Brain* (2018). DOI: 10.1093/brain/awy083

Provided by Vanderbilt University

patients.html