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Brain imaging specialists concentrate on connectivity, activation, and microangiopathies

By: Karen Sandrick

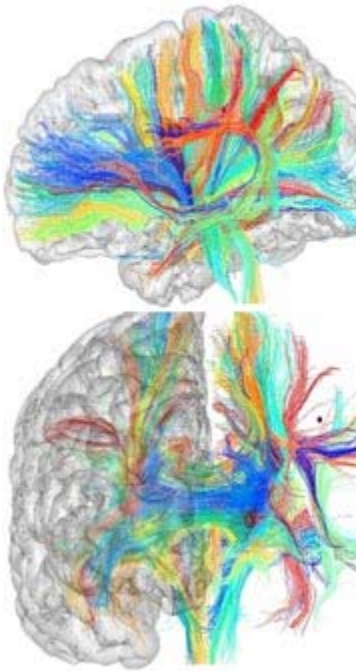
Profound improvements in perfusion and diffusion tensor imaging over the past few decades are changing the ways in which radiologists understand disease processes, especially those involving small blood vessels in the brai according to Dr. Jonathan Gillard of Cambridge University Hospital in the U.

Advancements such as diffusion MRI are now current practice, both for assessing the extent of acute ischemic disease to speed the treatment of stroke patients and for mapping white-matter fibers to identify for neurosurgeons which parts of the brain are functional and should not be touched during surgery, explained Dr. Denis Le Bihan, from NeuroSpin, CEA Saclay Center in Paris.

Future directions for diffusion MRI are not yet clear, but there are two potential applications, he said. The first relates to problems in communicati between various parts of the brain when, for example, the frontal lobe is nc talking to the hippocampus or not talking in the right way.

"There are some papers showing that in schizophrenia, depression, or autis the brain anatomy looks almost normal. The issue is that communication is well established, and communication goes through the white-matter fibers. if we have a way to map out white-matter fibers, we may be able to show t something is abnormal; there are not as many fibers as we expect, or the fibers are not well-organized. These are things that could be detected with diffusion tensor imaging," Le Bihan said.

Diffusion MRI also may be used to detect activation of the brain. During activation, the diffusion of water molecules slows down. The reason is not yet known, but it may be because neurons swell when they are activated. If diffusion MRI proves to be accurate in visualizing changes in the microscopic structure of tissues that occur during activation of the neurons, it could reveal a process that is intrinsically linked to brain activation.



Sagittal and coronal projectic of the white matter track connecting brain regions, a

"BOLD (blood oxygenation-dependent) MRI is an indirect way to detect brain activation. It detects an increase in the cerebral blood flow in the regions which have been activated. So we don't see activation; we see something related to it. With diffusion MRI, we could have a way to detect directly the regions that are activated," Le Bihan said.

These potential uses of MRI will require further technological developments to become reality. For one thing, diffusion MRI is not available on all MR systems. In addition, the acquisition of data requires

considerable postprocessing.

obtained with diffusion tens MRI. (Provided by C. Poupon al., NeuroSpin)

"Technical improvements are needed so that a radiologist or any clinician who would like to use diffusion MRI can just press a button on the scanner and get the results," Le Bihan said.

According to Prof. Anne Osborn, there are a couple of MRI sequences that c be done routinely today to reveal pathologies at the level of the blood vesse Osborn is executive vice president of Amirsys in Salt Lake City.

"Everyone can do gradient refocused T2 scans; every manufacturer has the The scans are just not used as much as they should be, and they can be ve revealing by providing a look at the microscopic disease processes," she sai

In her New Horizons lecture, Osborn plans to apply the general principle of "look small but see big" to show aspects of brain imaging that can affect wh radiologists do on a day-to-day basis.

She explained that radiologists commonly use a single, "wastebasket phras such as "small vessel vascular disease or microangiopathy of the brain," without recognizing that a wide variety of pathologies can account for differ imaging appearances. Yet with a constellation of imaging findings, radiologi can distinguish problems such as amyloid angiopathy from arteriolosclerosis with a high degree of certainty.

At today's session, Osborn planned to show how imaging studies reveal pathologies on all three sides of the microcirculation. In arterioles, MRI can reveal arteriolosclerosis as well as lipohyalinosis -- which are manifestations atherosclerosis -- and amyloid angiopathy, which has different disease underpinnings and imaging findings. At the capillary level, she was to expla what happens when capillary junctions do not function properly, and on the venous side of the circulation, she was to focus on autoimmune diseases.

"Is this the classic New Horizons lecture that predicts what imaging techniq will be used in five years? The answer is no. But there certainly is a new frontier for radiologists, and in a way, it has been there all along. It is to loo at microscopic disease processes and attempt to translate them into why w see what we see on imaging studies," she said.

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