New imaging techniques prove valuable tools to assess stroke risk

January 23 2012, By Doug Campbell

(Medical Xpress) -- Vanderbilt radiologists are rolling out powerful new imaging techniques that provide clearer pictures of the delicate ebb and flow of blood through brain tissue in patients at risk for stroke.

One of the neuroimaging techniques is called blood oxygenation level-dependent functional magnetic resonance imaging, or BOLD fMRI. It allows radiologists to non-invasively measure how near tissue is to exhausting its supply of blood, which is believed to be a sensitive indicator of stroke risk.

While BOLD fMRI is a popular research tool for cognitive neuroimaging, it is currently being used clinically at only a few centers across the country.

At Vanderbilt, Megan Strother, M.D., assistant professor of Radiology and Radiological Sciences and Neurological Surgery, and colleague Manus Donahue, Ph.D., are currently using the technique to assess the stoke risk of patients with Moyamoya, a complex disorder causing intracranial stenosis — the narrowing of arteries leading into the brain.

Patients with Moyamoya are at a heightened risk for stroke in the first two years after diagnosis, so the goal is to image them every three to six months within that time frame to help guide treatment decisions. Surgical intervention options include arterial bypasses and encephalo-dura-arterial synanastomosis (EDAS).

“The conventional way these patients would be evaluated is by doing a cerebral angiogram,” Strother said.

Although angiograms provide great pictures of the blood vessels, angiograms are invasive procedures which require neuro-interventionalists to access the artery with a small catheter through the patient’s groin, move the catheter through the patient’s aorta to the cervical vessels, and then image the injected contrast as it flows through the brain. Angiograms are high-risk invasive procedures which can cause complications including stroke. Additionally, patients are exposed to radiation and the contrast can harm patients’ kidneys.

These risks are eliminated with BOLD imaging. BOLD is non-invasive and does not expose patients to contrast or radiation. Instead of receiving contrast, patients breathe slightly elevated levels of carbon dioxide through a facemask while they lie in the MRI scanner. The carbon dioxide acts as a vasodilator, which increases the amount of oxygenated blood in vessels.

Water surrounding oxygenated and deoxygenated blood has different magnetic properties, and therefore MRI images acquired as the patients’ blood vessels dilate allow physicians to gauge tissue level hemodynamics – or changes in the amount of blood volume and blood flow. This allows clinicians to assess better the wide range of vascular compensation strategies that may be present, and whether patients have adequate blood supply beyond areas of arterial narrowing.

Strother said patients are thrilled with the ease of the 15-minute imaging technique, and more than 20 BOLD MRI scans have been performed over the past several months. She began investigating the feasibility of employing the technique at the urging of Vanderbilt neurosurgeons who treat patients with Moyamoya and who were discouraged by insufficient diagnostic imaging approaches available for this population.

A key component to implementing BOLD and to increasing the number of patients who can be assessed with the technique was the arrival last November of medical physicist Donahue from Johns Hopkins University. Donahue uses hemodynamic models to convert the data generated by the BOLD technique into physiologically meaningful maps of cerebral perfusion and blood volume reactivity that can be readily interpreted by clinicians.

Donahue has also added new noninvasive “vessel selective arterial spin labeling” approaches for quantifying collateral blood flow, or the precise manner by which tissue receives blood when a feeding vessel is occluded.

“BOLD imaging adds a critical piece in the puzzle to decide who needs surgical treatment, by identifying patients who are at highest risk for stroke,” Strother said.

Over the next few months, BOLD fMRI and other non-invasive measures of tissue-level hemodynamics will be added to MRI scans performed on Vanderbilt stroke patients. Strother and Donahue are working with Howard Kirshner, M.D., director of the Vanderbilt Stroke Center, on this initiative in hopes that these imaging techniques will be helpful in explaining the pathophysiology of stroke, potentially leading to refinements in stroke treatment and prevention.

Provided by Vanderbilt Medical Center