Non-invasive mapping helps to localize language centers before brain surgery

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A new functional magnetic resonance imaging (fMRI) technique may provide neurosurgeons with a non-invasive tool to help in mapping critical areas of the brain before surgery, reports a study in the April issue of *Neurosurgery*, official journal of the Congress of Neurological Surgeons.

Evaluating brain fMRI responses to a "single, short auditory language task" can reliably localize critical language areas of the brain—in healthy people as well as patients requiring brain surgery for epilepsy or tumors, according to the new research by Melanie Genetti, PhD, and colleagues of Geneva University Hospitals, Switzerland.

Brief fMRI Task for Functional Brain Mapping

The researchers designed and evaluated a quick and simple fMRI task for use in functional brain mapping. Functional MRI can show brain activity in response to stimuli (in contrast to conventional brain MRI, which shows anatomy only). Before neurosurgery for severe epilepsy or brain tumors, functional brain mapping provides essential information on the location of critical brain areas governing speech and other functions.

The standard approach to brain mapping is direct electrocortical stimulation (ECS)—recording brain activity from electrodes placed on the brain surface. However, this requires several hours of testing and

may not be applicable in all patients. Previous studies have compared fMRI techniques with ECS, but mainly for determining the side of language function (lateralization) rather than the precise location (localization).

The new fMRI task was developed and evaluated in 28 healthy volunteers and in 35 patients undergoing surgery for brain tumors or epilepsy. The test used a brief (eight minutes) auditory language stimulus in which the patients heard a series of sense and nonsense sentences.

Functional MRI scans were obtained to localize the brain areas activated by the language task—activated areas would "light up," reflecting increased oxygenation. A subgroup of patients also underwent ECS, the results of which were compared to fMRI.

Non-invasive Test Accurately Localizes Critical Brain Areas

Based on responses to the language stimulus, fMRI showed activation of the anterior and posterior (front and rear) language areas of the brain in about 90 percent of subjects—neurosurgery patients as well as healthy volunteers. Functional MRI activation was weaker and the language centers more spread-out in the patient group. These differences may have reflected brain adaptations to slow-growing tumors or longstanding epilepsy.

Five of the epilepsy patients also underwent ECS using brain electrodes, the results of which agreed well with the fMRI findings. Two patients had temporary problems with language function after surgery. In both cases, the deficits were related to surgery or complications (bleeding) in the language area identified by fMRI.

Functional brain mapping is important for planning for complex neurosurgery procedures. It provides a guide for the neurosurgeon to navigate safely to the tumor or other diseased area, while avoiding damage to critical areas of the brain. An accurate, non-invasive approach to brain mapping would provide a valuable alternative to the time-consuming ECS procedure.

"The proposed fast fMRI language protocol reliably localized the most relevant language areas in individual subjects," Dr. Genetti and colleagues conclude. In its current state, the new test probably isn't suitable as the only approach to planning surgery—too many areas "light up" with fMRI, which may limit the surgeon's ability to perform more extensive surgery with necessary confidence. The researchers add, "Rather than a substitute, our current fMRI protocol can be considered as a valuable complementary tool that can reliably guide ECS in the surgical planning of epileptogenic foci and of brain tumors."

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