

Public release date: 29-Aug-2006

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Preoperative brain mapping alters tumor surgery

OAK BROOK, Ill.-- By pinpointing the motor and language areas of the brain with functional magnetic resonance imaging (fMRI), surgeons can target brain tumors more effectively while reducing the risk of damaging important cognitive and motor processes, according to a study appearing in the September issue of *Radiology*. Half of the patients with brain tumors who were enrolled in an fMRI study at Duke University Medical Center in Durham, N.C., had their treatment strategies altered after these critical brain regions were identified prior to surgery.

"In patients who underwent fMRI, neurosurgeons estimated that more tumor was removed at surgery, operations were shorter and skull incisions were smaller, compared with what they would have had if the fMRI data were not available," said Jeffrey R. Petrella, M.D., associate professor of radiology in the neuroradiology division at Duke.

When brain tumors are located at the body's control center for thinking, sensation and movement, they can drastically affect a person's physical and cognitive abilities. In addition, surgical removal can be tricky because if key areas such as these are damaged, patients may experience postoperative symptoms such as limb weakness, language difficulties or partial blindness.

Each year, approximately 190,000 people are diagnosed with brain tumors in the United States, according to the National Brain Tumor Foundation. Additionally, more than 120 different types of brain tumors have been identified, making effective treatment planning difficult.

In the current study, 39 patients diagnosed with potentially operable brain tumors were evaluated with fMRI of the brain. During the imaging exam, they performed sentence completion tasks to map areas of the brain involved in language function, and hand-squeezing tasks to detect sensory motor areas. The entire procedure, including the time it took to train patients and acquire the images, took less than one hour.

The neurosurgeons who referred the patients for fMRI were given questionnaires to answer before and after fMRI to determine what effects, if any, the fMRI results had on their treatment plan. Surgeons also completed a postoperative questionnaire to confirm whether the post-fMRI plan was followed and to determine if fMRI findings affected surgical approach, the amount of time they spent in surgery and the surgical extent.

The researchers found that in 19 of 39 patients (49 percent), the surgeons significantly changed their treatment plans after receiving the fMRI findings. Eighteen of the 19 patients underwent more aggressive approaches than originally planned.

Additionally, the fMRI findings helped decrease surgical time by an estimated 15 to 60 minutes in 22 patients. In six patients who had surgery, the neurosurgeon specifically commented that knowledge of the fMRI results enabled a more complete resection than otherwise would have been achieved.

No neurological deficits were documented in any patients after undergoing surgical tumor removal.

After completing this study, Dr. Petrella believes that patients who may have previously been deemed ineligible for surgery based on tumor location may be able to undergo surgery safely, due to the valuable information available with fMRI.

"This is a pilot study. To establish whether fMRI can become a new standard of care, the next step is to assess whether patient outcomes are actually improved in a large multicenter trial with a control group," he said.

Co-author James T. Voyvodic, Ph.D., ascertained that the present study should help boost confidence in making fMRI part of diagnostic brain exams. "If it can be included in a routine MRI exam, it will be quicker, cheaper and more available than it is now," he explained.

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The Center for Medicare and Medicaid Services has recently approved reimbursement for fMRI services, effective January 1, 2007. fMRI is currently available at approximately 50 medical centers across the United States.

Journal attribution required.

Radiology is a monthly scientific journal devoted to clinical radiology and allied sciences. The journal is edited by Anthony V. Proto, M.D., School of Medicine, Virginia Commonwealth University, Richmond, Va. Radiology is owned and published by the Radiological Society of North America, Inc. (RSNA.org/radiologyjnl)

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"Preoperative Functional MR Imaging Localization of Language and Motor Areas: Effect on Therapeutic Decision Making in Patients with Potentially Resectable Brain Tumors."
Collaborating with Dr. Petrella on this paper were Lubdha M. Shah, M.D., Katy M. Harris, B.S., Allen H. Friedman, M.D., Timothy M. George, M.D., John H. Sampson, M.D., Ph.D., Joseph S. Pekala, M.D., and James T. Voyvodic, Ph.D.

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