SMRT Student Scope Submission

Title and Author

Title: fMRI of Brain Tumor

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Date of Submission: 12/1/2008

Introduction or Patient History

The patient is a 37 year old woman who had suffered a probable seizure while riding a roller coaster in May 2005. A CT scan demonstrated an intracranial abnormality and, ultimately, she underwent a craniotomy that same month. Oligodendroglioma was identified. She received 12 cycles of Temodar, ending in June 2005. She has been maintained on Keppra for seizures. On specific questioning, she denies any difficulty with headache, vision, hearing, or coordination. Her speech and balance have been good. She has seizures with stress, loud music, and around the time of her menstruation. She notes that she intermittently has difficulty with “bad tastes.” Her short-term memory seems to be somewhat impaired. A previous MRI from 2005 was available for review. This demonstrates a partially circumscribed mass measuring approximately 67 x 43 mm when contrast enhancement is added. After further evaluation by her doctor, a Functional MRI (fMRI) of the brain was ordered to identify language and left motor areas and their spatial relationship to the mass.

Patient Preparation and Scan Set up

The patient arrived in the MRI department. In order to make sure that she was safe to be placed in the scanner, the patient filled out a screening form. The form was reviewed with the patient. The patient was given specific instructions for the scan. For identifying language areas, she was instructed to perform a confrontational naming task, with generation of a sentence overtly to name animal figures presented to her during the scan. For identifying motor areas, the patient was instructed to perform right-handed sequential finger tapping. Because patient cooperation plays a vital role in the success of the study, these instructions were repeated before the scan began. The patient was placed in a Siemens 1.5 T scanner in a supine position on the scanning table with head going in first. The scanner was equipped with a viewing screen so the patient could view the

corresponding images. The patient's head was positioned in the head coil with the interpupillary line parallel to the surface of the scanning table. Soft sponges were used to restrict voluntary movement of the patient's head. Earplugs were provided to reduce the noise level during the scan. A knee cushion was placed under the patient's knees for comfort. A squeeze ball was given to the patient in the event of an emergency.

MR Imaging Parameters

Functional MR images were collected using a single-shot gradient-recalled EPI sequence and blood oxygenation level dependent (BOLD) contrast. Time series were 70 dynamic scans (3 "on" and 4 "off" blocks) for the motor tasks, and 90 dynamic scans (4 "on" and 5 "off" blocks) for the language tasks. BOLD images were obtained in the axial plane at TR/TE = 3000/35 ms, with 25 slices, 5 mm slice thickness and no gap. Anatomic images were collected using T1-weighted, T2-weighted and/or FLAIR sequences at the same slice planes as the BOLD images. Additionally, a 3D T1-weighted GRE sequence using 1 mm slice partitions were obtained for 3D volume rendering of the brain. Diffusion tensor imaging (DTI) was also performed. Subsequently, activation maps were calculated from multiple regression statistical analysis (SPM99) and t-test method after image realignment/co-registration to remove motion artifact. The functional maps were color-coded and overlaid on the anatomical images and multi-planar reformatted and/or shaded surface display (SSD) images to demonstrate functional areas. This was all performed off-line on a separate workstation.

Sequence	FOV	Slices	TR	TE	Matrix
Localizer	280x280	10	20 ms	5 ms	256x512
T2 Ax Flair	240x240	5	10,000 ms	130 ms	440x512
T2 Ax FS	240x240	5	4150 ms	107 ms	192x256
T1 Ax	240x240	5	454 ms	17 ms	192x320
BOLD	1200x1200	5	3000 ms	30 ms	64x64

Findings and Discussions

The results of the study showed that the patient is reportedly right-handed, and does not demonstrate any obvious impairment of motor function. For the language task, there is activation in the inferolateral left frontal lobe, adjacent to the anterior, superior margin of the mass (as defined by the region of abnormal signal intensity). There is also activation immediately adjacent to the posterior margin of the mass. For the motor task, there is activation in the left precentral gyrus, remote from the margins of the mass (as defined by the abnormal signal intensity). There is expected activation in the left supplementary motor area (SMA), also remote from the mass. There is also activation in the right parietal lobe, remote from the mass.

Conclusions

According to Cedars-Sinai, "An oligodendroglioma tumor is a slow-growing brain tumor that usually occurs in young adults. These tumors are frequently located within the frontal, temporal or parietal lobes and cause seizures in a relatively high percentage of patients." This is interesting because the first symptom the patient in this study experienced was a seizure and their mass was in their frontal and temporal lobes.

Wikipedia states, “In anywhere from fifty to eighty percent of cases, the first symptom of an oligodendroglioma is the onset of seizure activity. Headaches combined with increased intracranial pressure are also a common symptom of oligodendroglioma. Depending on the location of the tumor, any neurological deficit can be induced, from visual loss, motor weakness and cognitive decline. A Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) scan is necessary to characterize the anatomy of this tumor (size, location, heter/homogeneity). However, final diagnosis of this tumor, like most tumors, relies on histopathologic examination (biopsy examination).”

“Treatment options include surgery, radiation, and chemotherapy. Which type of treatment to use is a complex decision and requires in-depth discussions with expert physicians. For recurrent low-grade oligodendroglial tumors, surgery, radiation, and chemotherapy may each play an important role. Surgically removing the tumor may reduce symptoms. If radiation therapy was not administered initially, it is likely to be effective for recurrent disease. Response to chemotherapy (temozolomide) has occurred in approximately 50 percent of patients with low-grade oligodendroglioma that recurs after radiation,” according to the Mayo Clinic.

This study was important because the physicians wanted to know the language and motor areas of the patient’s brain as they related spatially to the mass. fMRI is sensitive to blood flow, providing information regarding the nerve activity of the brain. Because of this sensitivity, functional MRI is different than conventional MRI and CT. This is something I did not know before I participated in the study. MRI is more effective at imaging soft tissue, versus CT which images bony structures more effectively. This is why MRI is the preferred modality for imaging brain tumors.

References

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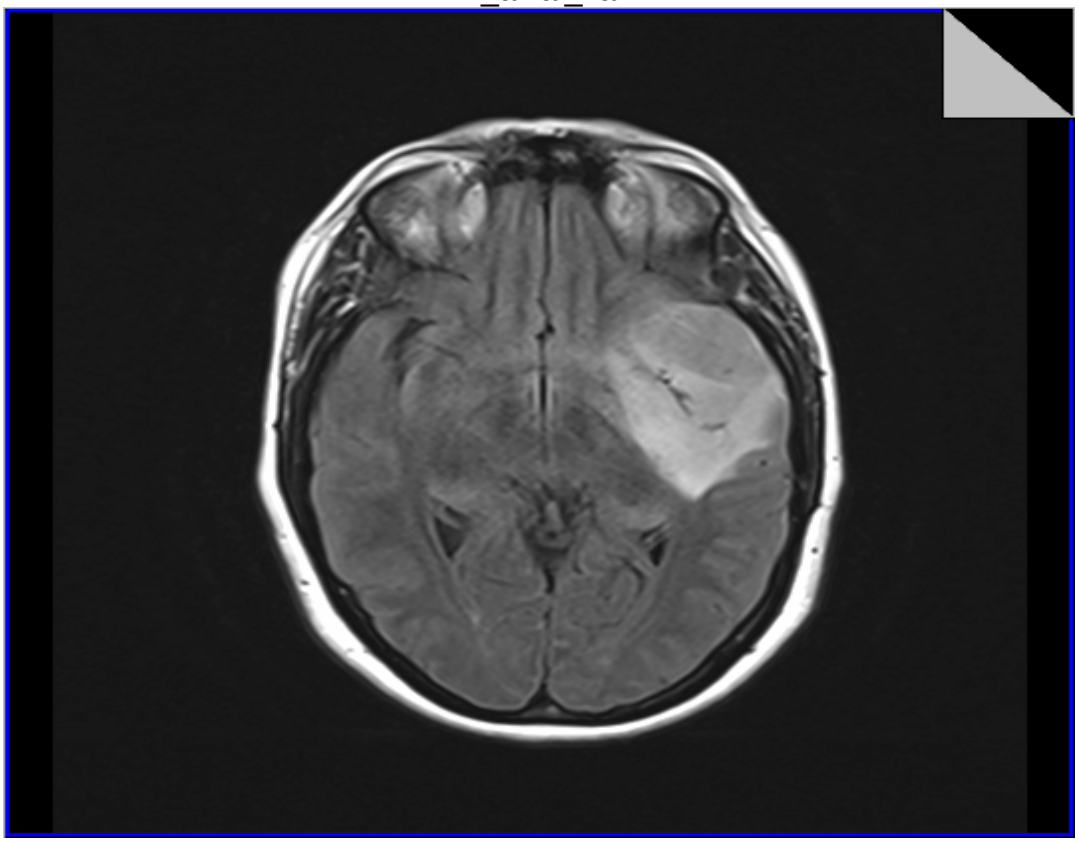
Images

T2_axial_flair



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