

## SPIKE-TRIGGERED *f*MRI TO LOCALIZE MEDIAL FRONTAL SPEECH AREA

### Postoperative Speech Disorder after Medial Frontal Surgery: Role of the Supplementary Motor Area

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**BACKGROUND:** Patients undergoing surgical resection of medial frontal lesions may present transient postoperative speech disorders that remain largely unpredictable. **OBJECTIVE:** To relate the occurrence of this speech deficit to the specific surgical lesion of the supplementary motor area (SMA) involved during language tasks using *f*MRI.

**METHODS:** Twelve patients were studied using a verbal fluency task before resection of a low-grade glioma of the medial frontal lobe and compared with six healthy subjects. Pre- and postoperative MR variables including the hemispheric dominance for language, the extent of SMA removal, and the volume of resection were compared to the clinical outcome.

**RESULTS:** Following surgery, 6 of 12 patients presented speech disorders. The deficit was similar across patients, consisting of a global reduction in spontaneous speech, ranging from a complete mutism to a less severe speech reduction, which recovered within a few weeks or months. The occurrence of the deficit was related to the resection of the activation in the SMA of the dominant hemisphere for language ( $P < 0.01$ ). Increased activation in the SMA of the healthy hemisphere on the preoperative *f*MRI was observed in patients with postoperative speech deficit.

**CONCLUSIONS:** *f*MRI is able to identify the area at risk in the SMA, of which resection is related to the occurrence of characteristic transient postoperative speech disorders. Increased SMA activation in the healthy hemisphere suggested that a plastic change of SMA function occurred in these patients.

### COMMENTARY

Patients undergoing resection of a medial frontal lobe lesion frequently develop a transient postoperative speech disorder, which may be related to excision within the supplementary motor area. The postoperative neurological disorder is characterized by a decrease in spontaneous speech and a marked reduction in speech output, including mutism. The deficit is unpredictable, highly variable in occurrence and severity, and typically improves over several weeks to months.

Currently, there is no reliable way to predict which patients will face this postoperative neurological complication. At present, the only methodology used to detect frontal lobe language regions is extraoperative cortical stimulation mapping—an invasive procedure that does not lend itself to repeated studies. The development of a noninvasive technique to lateralize language areas would represent a significant advance in prevention of postoperative speech disorders. Functional MRI (*f*MRI) is a procedure that provides images with excellent spatial resolution. It is a hemodynamic indicator of neuronal activity as associated with the performance of a specific task, (e.g., using verbal fluency tasks to activate the frontal lobe). Importantly, it is a noninvasive approach to localizing frontal lobe language areas.

The present study by Krainik and colleagues evaluates the use of *f*MRI in 12 patients scheduled for excision of low-grade gliomas located in the medial frontal lobe. The patients underwent neuropsychological studies and language evaluation before and after surgery. None of the patients had a preoperative speech deficit. Eight of the 12 patients had lesions in the left frontal lobe and all of these individuals were right handed. Two of the four patients with right frontal lobe lesions were right handed and two were left handed. The *f*MRI studies used an auditory-cued semantic fluency test to locate areas active for language. The *f*MRI was also used to determine hemispheric language dominance. In all patients, the left hemisphere was dominant for language. Activation of the supplementary motor area was bilateral in the 12 patients.

Six of the 12 patients had a transient global reduction in speech output after surgery. Patients with a postoperative speech alteration had increased activation of at least 16% of the contralateral supplementary motor area of the healthy hemisphere on the *preoperative f*MRI. There was a relationship between the occurrence of the deficit and the percentage of resection of the supplementary motor activation in the dominant



hemisphere for language. The presence of the neurological alteration did not correlate with the size or volume of tumor. It was suggested that the increased activation within the supplementary motor area of the healthy hemisphere might indicate plasticity in these patients.

Previously, it had been shown that *fMRI* could determine hemisphere dominance for language. The present study augments this line of research by demonstrating that resection of the supplementary motor area in the medial frontal lobe is associated with postoperative speech deficit. Importantly, Krainik and colleagues have shown that *fMRI* prior to resection is able

to identify discrete areas within the medial frontal region involved with language (verbal fluency) tasks, and thus, potentially avoid troubling speech deficits associated with surgery. The finding may prove useful in counseling patients with medial frontal lesions and setting a course of treatment. The current study is provocative and will require confirmation and validation. Furthermore, it would be valuable to determine whether similar results could be confirmed in patients without lesional pathology.

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