

The Role of Preoperative Functional MRI in Brain Tumor Resection by Awake Craniotomy: Initial Experience in 22 Glioma Patients

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Learning Objectives

By the conclusion of the session, participants should be able to 1) describe the importance of early surgical intervention for patients with low-grade glioma; 2) discuss, in small groups, the potential usefulness of pre-operative functional magnetic resonance imaging (fMRI) to guide surgical decisions for patients with tumors near eloquent brain regions; and 3) identify specific ways that preoperative fMRI can impact patient management.

Introduction

For patients with tumors near eloquent brain regions, awake craniotomy (AC) procedures are an important treatment option to maximize the extent of resection (and thus survival) while minimizing possible surgical side-effects. Use of AC, including intra-operative brain mapping by electrical stimulation, is particularly important for patients with low-grade glioma as gross total resection can substantially prolong survival. Initial evidence also shows that AC benefits from use of preoperative functional magnetic resonance imaging (fMRI), to assist surgical decision-making. Here we report our initial experience with preoperative fMRI of 22 glioma patients, testing the hypotheses that fMRI has

Methods

Pre-operative fMRI involved a battery of motor and language mapping tasks (Fig.1) undertaken using a novel computerized tablet system (Fig.2), recently also modified for use in the operating room during AC (*Abstract No. 323*). Intraoperative mapping results were video-recorded and used to validate fMRI results.



Figure 1: Functional MRI maps for language and motor tasks. (Blue = Broca's area, Green = Wernicke's area, Pink = Superior parietal lobule, White = motor cortex)



Figure 2: fMRI-compatible tablet with writing stylus. Tablet rests over subjects lap and visual stimuli are presented through a rear projection system

Results

Thus far, 22 glioma patients (WHO grades I-III) between ages 18 to 70 (mean 41) have undergone preoperative fMRI. Sixteen patients underwent an AC with intraoperative mapping, 3 underwent surgical resection asleep, and 3 proceeded with alternative treatment options.



Figure 3: Results displaying good spatial agreement between fMRI and intraoperative mapping data for three patients who performed a work generation task In 19 patients, preoperative fMRI influenced surgical decisions by dictating the surgical approach or technique. Functional MRI maps were validated within a 5 mm radius when compared with intraoperative mapping results (Fig.3).

Table 1: Patient Demographics					
Subj.	Sex	Age	Handed -ness	Lesion location	LGG = low grade glioma; HGG = high grade gluoma
1	М	41	R	R-frontal	LGG
2	м	42	L	R-frontal	HGG
3	м	18	R	R-parietal	LGG
4	М	46	L	R-frontal	LGG
5	М	21	R	R-frontal	LGG
6	М	70	R	R-temporo-occipital	HGG
7	F	35	R	L-fronto-parietal	LGG
8	F	37	R	L-frontal	LGG
9	М	54	R	L-parietal	Metastasis
10	М	43	L	L-parietal	LGG
11	F	38	R	R-frontal	LGG
12	F	23	R	L-insular	LGG
13	М	55	R	R-temporo-parietal	LGG
14	F	25	L	R-frontal	HGG
15	F	47	R	L-frontal	LGG
16	F	48	R	L-insular	HGG
17	М	60	R	L-frontal	LGG
18	F	35	R	L-parietal	LGG
19	М	22	R	R-parietal	HGG
20	F	53	R	R-temporo-parietal	HGG
21	F	72	R	L-parietal	LGG
22	М	27	R	R-frontal	LGG
23	М	40	L	R-frontal	LGG
24	М	45	R	R-frontal	LGG
Overall	14 M 10 F	Mean 41 yrs	19 R 5 L	14 R-sided 10 L-sided	17 LGG 6 HGG 1 non-primary

Conclusions

Preoperative fMRI provides useful planning information with sufficient spatial accuracy to assist in the surgical management of glioma patients. This work provides rationale for conducting future multi-centre studies of our methodology to assess shortterm and long-term patient outcomes.

References

1.Tam F, Churchill N.W, et al. 2011, Human Brain Mapping, 32(2): 240-48