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Clinical Study

Awake right hemisphere brain surgery

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We report the indications and outcomes of awake right hemispheric brain surgery, as well as a rare patient with crossed aphasia. Awake craniotomies are often performed to protect eloquent cortex. We reviewed the medical records for 35 of 96 patients, in detail, who had awake right hemisphere brain operations. Intraoperative cortical mapping of motor and/or language function was performed in 29 of the 35 patients. A preoperative speech impairment and left hand dominance were the main indicators for awake right-sided craniotomies in patients with right hemisphere lesions. Four patients with lesion proximity to eloquent areas underwent awake craniotomies without cortical mapping. In addition, one patient had a broncho-pulmonary fistula, and another had a recent major cardiac procedure that precluded awake surgery. An eloquent cortex representation was identified in 14 patients (48.3%). Postoperatively, seven of 17 patients (41.1%) who presented with weakness, experienced improvements in their motor functions, 11 of 16 (68.7%) with seizures became seizure-free, and seven of nine (77.7%) with moderate to severe headaches and one of two with a visual field deficit improved significantly. There were also improvements in speech and language functions in all patients who presented with speech difficulties. A right sided awake craniotomy is an excellent option for left handed patients, or those with right sided cortical lesions that result in preoperative speech impairments. When combined with intraoperative cortical mapping, both speech and motor function can be well preserved.

1. Introduction

Brain surgery under local, rather than general anesthesia, was first employed for epilepsy surgery in the 1930s because it allowed real time, intraoperative communication between the surgeon and patient [1]. Awake craniotomies for brain tumor resection are often performed today as a way of shielding the brain's eloquent cortices, particularly those that are responsible for language and motor skills, from intraoperative damage [2–5]. The direct feedback, obtained by speaking to the patient and observing both their language and motor functions, provides a more effective monitoring modality than that obtained using evoked potentials. Intraoperative brain mapping using bipolar stimulation further enhances this feedback by allowing surgeons to definitively identify the eloquent regions [6,7]. When there is a motor or speech deficit during an awake craniotomy, the lesion resection can be modified immediately. Additionally, awake craniotomies can potentially reduce resource utilization, and can result in shorter intensive care unit and hospital stays [2,8,9].

Since the 1990s, awake craniotomies have been augmented by improved imaging technology. Eloquent regions are subject to substantial anatomical variance among patients, and the use of preoperative functional MRI (fMRI) has allowed neurosurgeons to identify the eloquent brain areas in a patient-specific manner [10–13]. Combined with intraoperative neuronavigation, fMRI has further enhanced the safety of awake craniotomies for resection of tumors or epileptic foci, which previously had the potential to significantly damage eloquent regions of the brain [5,14–16].

The human brain is composed primarily of non-nociceptive tissue, and the majority of patients do not retrospectively report significant pain when undergoing awake craniotomies for resection of intracranial lesions [2,17–21]. Studies have shown that the proper patient preparation for awake craniotomy can result in a more favorable perception of the experience, including fewer complaints of fear, claustrophobia, and anxiety [19,20]. An awake craniotomy should not be performed in patients who are unable to cooperate due to emotional instability, mental retardation, or an insurmountable language barrier [22].

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Approximately 90% of patients are right hand dominant, and the cortices responsible for language functions are located on the left side of the brain. Consequently, awake craniotomies are most often performed for left hemisphere lesions [23]. Such lesions, including those within or adjacent to the eloquent regions, are commonly resected under local rather than general anesthesia [8]. However, on the right side, awake craniotomies are less common because language representation in the right hemisphere regions is infrequent. In this study, we sought to report the indications for a right sided awake craniotomy, and to examine the outcomes for patients who underwent such procedures.

2. Methods

Institutional Review Board approval for viewing images and medical records of patients undergoing open cranial surgery was obtained before the initiation of this retrospective study. The study was compliant with the Health Insurance Portability and Accountability Act.

2.1. Patient population

Using a hospital-based computer registry, we identified 96 patients who underwent awake brain surgery at Brigham and Women's Hospital between January 2003 and July 2014. Medical records were reviewed in detail for 35 patients who had awake right sided craniotomies. These included a variety of lesion histological types, locations, and patient presentations. The contraindications for awake surgery included the patient's inability to cooperate because of a severe language barrier, emotional instability or mental retardation. The patients with occipital lesions who were placed in the prone or semi-prone positions were operated under general anesthesia. One rare patient with crossed aphasia (aphasia from a right hemisphere lesion in a right handed patient) was identified and evaluated in greater detail.

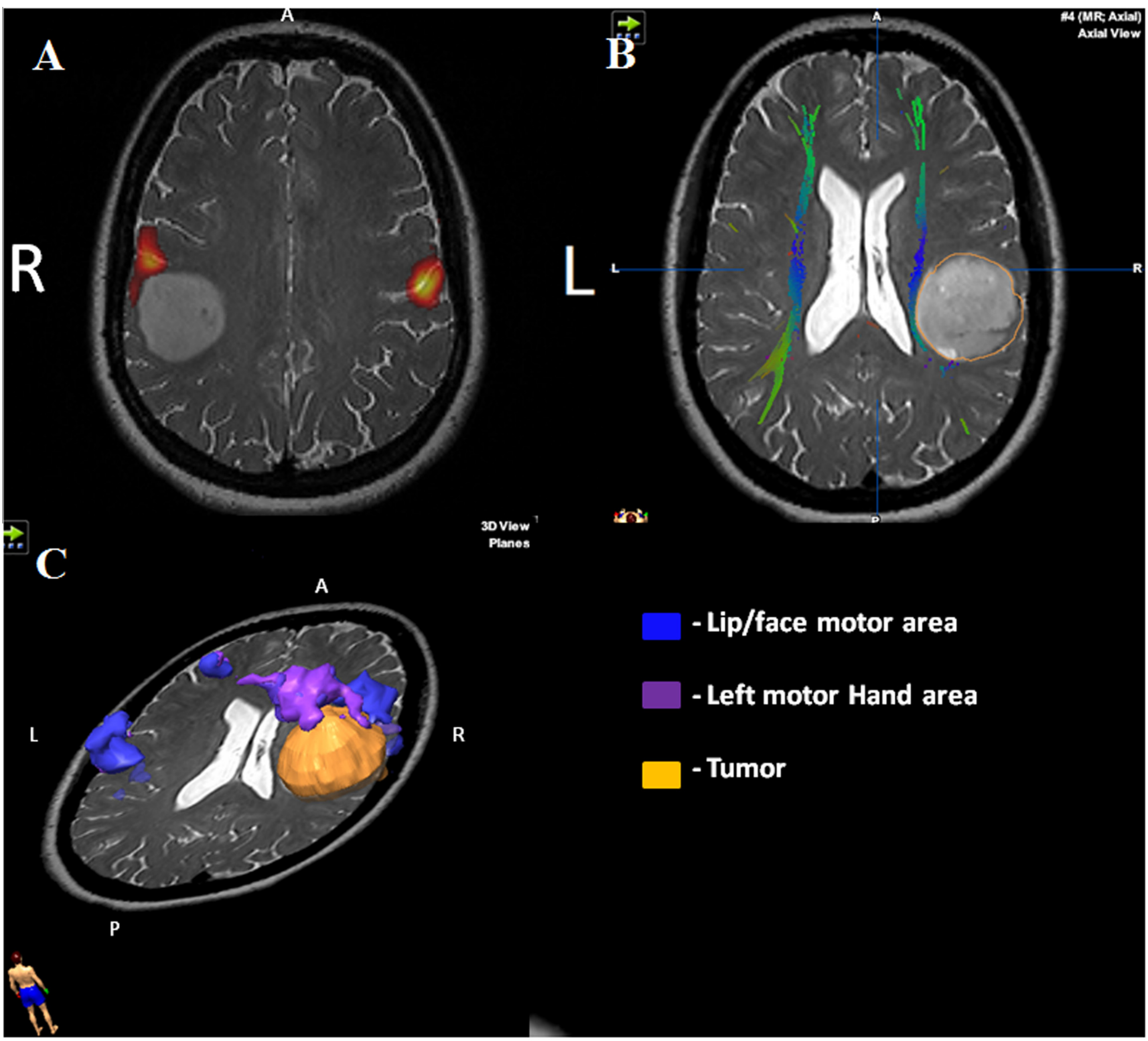

Fig. 1. Preoperative axial functional MRI motor mapping in a 35-year-old left handed woman with a right hemisphere glioma. (A) Axial T2-weighted fast spin echo MRI. The red regions represent activated primary motor lip areas. (B) Axial gradient echo planar imaging and diffusion tensor imaging-based identification of the white matter tracts. An adjacent tumor (outlined in orange) compresses the tracts medially. (C) 3D reconstruction of the primary motor area (blue and purple) and adjacent glioma (yellow). A = anterior, L = left, P = posterior, R = right.