Combined Use of Minimal Access Craniotomy, Intraoperative Magnetic Resonance Imaging (MRI), and Awake Functional Mapping for the Resection of Gliomas in 61 Patients

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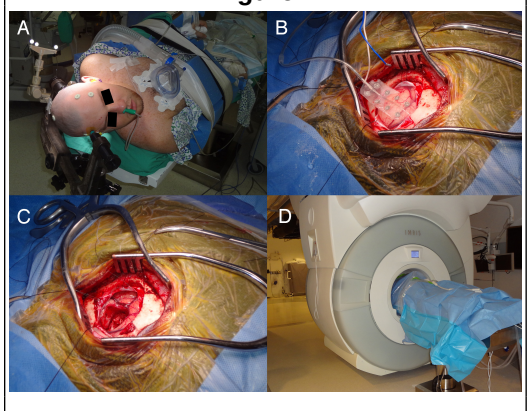
Introduction

Current management of gliomas involves a multidisciplinary approach, including a combination of maximal safe surgical resection, radiotherapy, and chemotherapy. The use of intraoperative magnetic resonance imaging (MRI) helps to maximize extent of resection, and use of awake functioning mapping supports preservation of eloquent areas of the brain. We report here on the concurrent use of these surgical adjuncts.

Methods

We performed a retrospective review of patients with gliomas, who underwent surgical resection in our intraoperative MRI suite (IMRIS) with awake functioning mapping between 2010 and 2017. Patient demographics, tumor characteristics, intraoperative and postoperative adverse events, and treatment details were obtained. Volumetric analysis of preoperative tumor volume and intraoperative and postoperative residual volumes was performed.

Figure 1

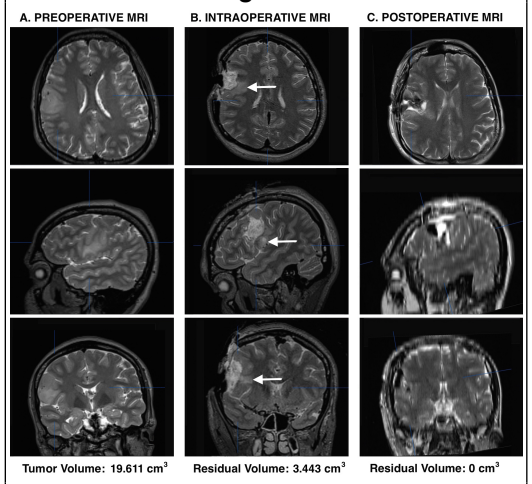


Intra-operative images demonstrating prepping, awake mapping, tumor resection, and iMRI

Results

A total of 61 patients requiring 62 tumor resections met the inclusion criteria. 45.9% of the tumors resected were WHO grade I or II and 54.1% were WHO grade III or IV. Intraoperative neurophysiological monitoring modalities included speech alone in 23 cases (37.1%), motor alone in 24 (3.7%), and both speech and motor in 15 (24.2%). intraoperative MRI (iMRI) demonstrated residual tumor in 47 cases (75.8%), 41 of which (87.2%) underwent further resection. Median extent of resection (EOR) on iMRI and postoperative MRI were 86.0% and 98.5%, respectively, with a mean difference of 10% and a median difference of 10.5% ($p<0.001$). 17 or 62 cases achieved an increased EOR of more than 15% related to use of iMRI. 17 of 28 low-grade gliomas (60.7%) and 10 of 33 high-grade gliomas (30.3%) achieved complete resection. Significant intraoperative events included at least temporary new or worsened speech alteration in 7 out of 38 cases that underwent speech mapping (18.4%), new or worsened weakness in 7 out of 39 cases that underwent motor mapping (18.0%), numbness in 2 cases (3.2%), agitation in 2 (3.2%), and seizures in 2 (3.2%). Among the patients with new intraoperative deficits, 2 had residual speech difficulty, and 2 had weakness postoperatively, which improved back to baseline by 6 months.

Figure 2



Preoperative MRI image demonstrating the tumor before resection (A), intra-operative (B), and post-operative MRI images (C) showing residual tumor after resection. All measurements were made with semi-automated volumetric analysis tool (Brainlab iPlan (r)). Arrows denote residual tumor volume.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) understand and describe the high degree of coordination and proper technique to successfully combine the use of iMRI, awake functioning mapping, and minimal access craniotomy, 2) Discuss among small groups the feasibility of such coordination in different hospital settings/environments with differing resources, and 3) Identify this technique as a safe and effective approach to tumors located within or around eloquent tissue areas

Conclusions

In our retrospective case series the combined use of intraoperative MRI and awake functional mapping was demonstrated to be safe and feasible. This combined approach allows us to achieve the dual goals of maximal tumor removal and minimal functional consequences in patients undergoing glioma resection.

References

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