A method for safely resecting anterior butterfly gliomas: the surgical anatomy of the default mode network and the relevance of its preservation

Joshua D. Burks, BA1; Phillip A. Bonney, BS1; Andrew K. Conner, MD1; Chad A. Glenn MD1; Robert G. Briggs, BS1; James D. Battiste, MD PhD2; Tressie McCoy, PT DPT1; Daniel L. O’Donoghue, PhD3; Dee H. Wu, PhD4; and Michael E. Sughrue, MD1

1Department of Neurosurgery, 2Department of Neurology, 3Department of Cell Biology, 4Department of Radiological Sciences; University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma

Background: Gliomas invading the anterior corpus callosum are commonly deemed unresectable due to an unacceptable risk/benefit ratio including the risk of abulia. In this study, we investigate the anatomy of the cingulum and its connectivity within the default mode network. We describe a technique involving awake subcortical mapping with higher attention tasks to preserve the cingulum and reduce the incidence of postoperative abulia for patients with so-called butterfly gliomas.

Methods: We performed a review of clinical data on all patients undergoing glioma surgery performed by the senior author during a four-year period at our institution. Forty patients were identified who underwent surgery for butterfly gliomas. Each patient was designated as having undergone surgery either with or without the use of awake subcortical mapping and preservation of the cingulum. Data recorded on these patients includes the incidence of abulia/akinetic mutism. In the context of our findings, we conducted a detailed anatomic study of the cingulum and its role within the default mode network using postmortem fiber tract dissections of 10 cerebral hemispheres and in vivo diffusion tractography of 10 healthy subjects.

Results: We treated 40 patients with butterfly gliomas, 25 (62%) with standard surgical methods and 15 (38%) with awake subcortical mapping and preservation of the cingulum. 1/15 (7%) patient experienced postoperative abulia following surgery with the cingulum-sparing technique. We achieved greater than 90% resection in 13/15 (87%) of these patients.

Conclusions: We present evidence that anterior butterfly gliomas can be safely removed using a novel attention-based awake brain surgery technique that focuses on preserving the anatomic connectivity of the cingulum and relevant aspects of the cingulate gyrus.