Investigation of Asleep versus Awake Motor Mapping in Resective Brain Surgery

Derrick Murcia[1], Shawn D'Souza[1], Mohab Abozeid, MD[1], John A. Thompson, PhD[1], Teguo Daniel Djoyum, MPH[1]
David R. Ormond, MD, PhD[1]

[1] Department of Neurosurgery, University of Colorado School of Medicine, Aurora, CO, United States

Introduction

Aims:

- To develop an asleep motor mapping paradigm for accurate detection of corticospinal tract (CST) during glioma surgery
- Compare outcomes with awake versus asleep patients undergoing surgery with this new paradigm

Hypothesis:

- We anticipate that no significant difference will exist between awake versus asleep patients undergoing resective brain surgery

Rationale:

- Brain tumors are often adjacent to brain eloquent areas (BEA) which complicates surgical resection
- Awake surgery is expensive, invasive to patients, and requires extensive personnel to perform

Introduction:

- The CST is a major white matter tract that is involved with motor function
- Patients with BEA tumors who are not candidates for awake surgery or are local to hospitals who can not perform awake surgery have few surgical options
- Motor mapping is a technique used during surgery to differentiate tumor from healthy brain tissue. Stimulating the motor homunculus can predict, which part of the body will move.
- Recordings of evoked action potentials (eAPs) on EEG using motor mapping allows neurosurgeons to maximize extent of resection (EOR) and minimize deficits

Methods:

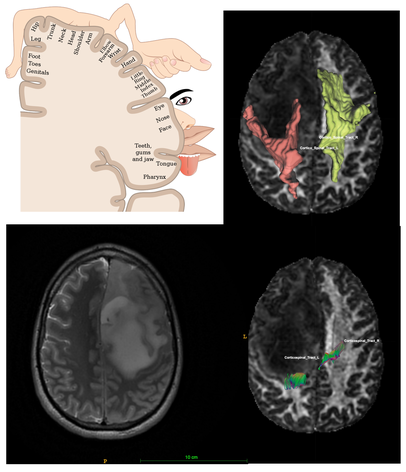

Figure 1. Motor Homunculus and Extraction of CST. Example of Motor Homunculus and MRI image sequences depicting a high-grade glioma with CST extraction.

Study Characteristics:

- N= 39(16 asleep, 23 awake)
- Retrospective cohort study
- DSI and ITK-Snap for image processing
- Primary endpoints: EOR and neurological deficits at 3 months post op

Results: Novel Asleep Motor Mapping Paradigm

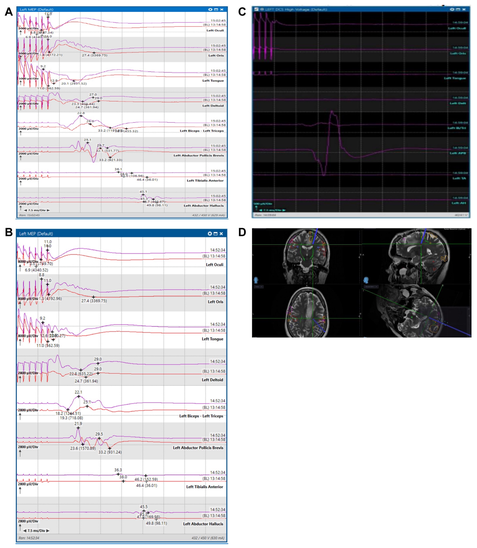

Figure 2. Evoked AP Recordings in an Asleep Patient and Stealh Navigation illustrating Site of Stimulation. A-C) Example of eAPs recorded during surgery. D) Stealth navigation demonstrating site of stimulation.

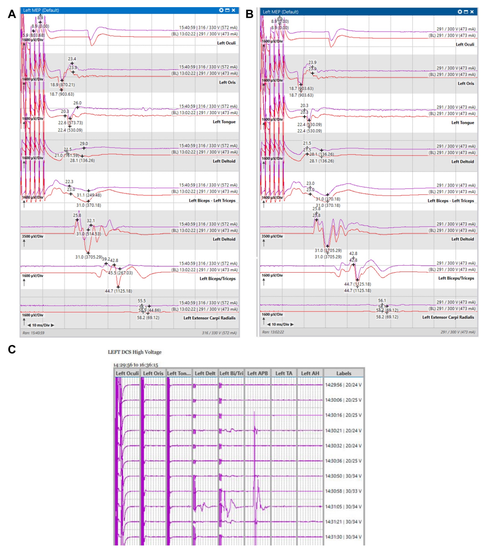

Figure 3. Evoked AP Recordings Demonstrating Movement in an Awake Patient A-C) Example of eAPs in a patient that underwent awake surgery for resection of a glioma.

Discussion

Extent of Resection:

- EOR was greater in the asleep group (mean [SD] EOR 88.71% [17.56%]) versus the awake group (mean [SD] EOR 80.62% [24.44%]), although this difference was not statistically significant (P = 0.3802).

Neurological Deficits at Follow-up:

- 16 of 17 asleep patients and 23 of 26 awake patients were stable or improved in regard to motor function after surgery (*P* = 1.000).

Significance:

- A Novel asleep paradigm is significantly less invasive compared to awake surgery and is less expensive
- Hardware adapted for this study can be distributed to hospitals without capabilities to do awake surgery

Improvements:

- Increase sample size
- Apply technique to other tumor pathologies

Future Directions:

- Incorporate local community hospital centers in a multi-institutional study

References

Giampiccolo D, Nunes S, Cattaneo L, Sala F. Functional Approaches to the Surgery of Brain Gliomas. *Adv Tech Stand Neurosurg*. 2022;45:35-96. doi:10.1007/978-3-030-99166-1_2

Murcia D, D'Souza S, Abozeid M, Thompson JA, Djoyum TD, Ormond DR. Investigation of Asleep versus Awake Motor Mapping in Resective Brain Surgery. *World Neurosurg*. 2022;157:e129-e136. doi:10.1016/j.wneu.2021.09.119

Acknowledgements

Special thanks to Drs. Thompson and Ormond for project supervision and mentorship, and Department of Neurosurgery for financial aid.

Contact Information

Email address: derrick.murcia@cuanschutz.edu