SNO MAXIMAL SAFE BRAIN TUMOR RESECTION: INTRAOPERATIVE VISUALIZATION AND THE CONNECTOME CONFERENCE

Submission Categories and Abbreviations:
Brain Mapping -- BRMP
Connectome -- CNTM
Fluorescence-guided Surgery -- FLGS
Intraoperative Tumor Diagnosis -- IOTG
Intraoperative Tumor Visualization Technologies -- ITVT
Tractography/White Matter Pathways – TWMP

BRAIN MAPPING

BRMP-01. AWAKE CRANIAL SURGERY WITH INTRAOPERATIVE LANGUAGE MAPPING FOR BRAIN TUMORS. A SINGLE-CENTER EXPERIENCE

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BACKGROUND: Maximal safe resection of brain tumors affecting language areas has been a matter of increasing interest worldwide in the last decades. Functional MRI, tractography, and awake cranial surgery are standard procedures in our department since 2006. The aim of this study was to describe our experience in a series of 58 patients who underwent awake cranial surgery with intraoperative language mapping. METHODS: Retrospective study of 58 adult patients who underwent awake surgery for brain tumors between January 2006 and January 2021. Preoperative neuropsychological assessment served as inclusion criteria. Language was evaluated according to the BDAE (Boston diagnostic aphasia examination) and WAB (Western aphasia battery) and strength according to the MRC (Medical Research Council) motor scale in the preoperative, immediate postoperative, and 3-months follow up. Functional MRI and tractography depicting white-matter tracts, neuronavigation, cortical and subcortical stimulation were performed in all cases. Conscious sedation was the anesthetic technique (propofol, fentanyl, and NSAIDs). Minimum follow-up was 6 months. FINDINGS: The average age was 35 years (16–74). The anatomopathological findings were: low-grade glioma in 75,8% (n = 44), high-grade glioma in 15,6% (n = 9) and others in 8,6% (n = 5). No complications were registered during postoperative course. At the immediate postoperative evaluation 65% of patients presented with speech disturbances but at the 3-months follow up speech recovery was observed in all cases. Only 1 patient remained with moderate aphasia. mRS score at 3- months follow up was ≤ 1 in 96% of patients. Two patients had a persistent moderate hemiparesis. CONCLUSION: Tumor resection in awake patients showed to be a safe procedure, and well tolerated by the patients. Preoperative planning of anatomical and functional aspects and intraoperative neurophysiological assessment are the cornerstones for pursuing maximal safe resection. KEYWORDS: Speech monitoring; awake cranial surgery; intra-operative neurophysiological monitoring; neuronavigation; language cortex surgery.

BRMP-02. FEASIBILITY AND EVALUATION OF A NOVEL LANGUAGE PARADIGM FOR INTRAOPERATIVE LANGUAGE TESTING

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INTRODUCTION: Mapping language during direct cortical stimulation (DCS) in the stetting of awake craniotomy might be challenging without using more than one language paradigm. Applying several language tasks leads to increasing surgery times and to patient's exhaustion. Additionally, a single language trial must be performed in less than 4 seconds to avoid DCS-induced seizures. Therefore, we aimed to design a single language paradigm which pictures highly relevant language functions and simultaneously restrains the assessment time of single language trials up to 4 seconds. METHOD: The intraoperative language task comprised a combination of picture naming and verb generation. During DCS patients should generate correct sentences according to the language stimulus by not exceeding 4 seconds. To assess the intraoperative feasibility of the language task we included 30 healthy subjects in a pilot study to measure subjects' speed of performing a single language task trial and to evaluate the language paradigm according to its language sensitivity by using the paradigm as a task for functional MRI. Intraoperatively, 21 patients with brain tumors in language associated brain areas were included. Patients received neuropsychological testing before and after surgery. RESULTS: The pilot study showed in healthy subjects that by applying the novel paradigm during fMRI there is activation in a left accentuated network of inferior frontal and parietal regions and the superior and middle temporal gyrus ($p<.05$, FEW). It was feasible to conduct a single language trial of the novel paradigm in a time frame of 4s (performance speed 2.53 s; SD=.32s). Intraoperatively, tumor patients showed DCS-associated language errors while conducting the language task. Postoperatively, mild language but no other neuropsychological deteriorations compared to presurgical assessment were observed ($p<.05$). CONCLUSION: We present a novel language paradigm which safely pictures and monitors highly relevant language functions and consequently can minimize postoperative language deficits.

BRMP-03. PITUITARY CARCINOMA: A CASE OF DRAMATIC RESPONSE TO IMMUNOTHERAPY (IPILIMUMAB + NIVOLUMAB) AFTER FAILURE WITH TEMOZOLOMIDE

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INTRODUCTION: Pituitary carcinoma (PC) accounts for just 0.1% of all pituitary tumors, often recurs following resection, and has a median reported survival of 1 year. Current treatment guidelines are not standardized but combine surgical resection, radiation therapy, and chemotherapy [1]. Temozolomide is the only chemotherapeutic with documented effectiveness, and the only recommended agent for aggressive pituitary carcinomas in ESE clinical guidelines [3]. CASE: A 57-year-old male presented with visual deterioration over a three-month period. Ophthalmologic evaluation revealed bitemporal visual field deficits. MRI brain W/WO demonstrated a sellar mass suspected to be pituitary macroadenoma with displacement of the stalk and optic nerve impingement (Figure 1a). The patient underwent stereotactic endoscopic transsphenoidal resection of the mass [2]. Postoperative MRI demonstrated gross total resection (Figure 1b). Pathology revealed a sparsely granulated corticotroph-adenoma with malignant transformation (early in-situ PC). Immunohistochemistry showed LOE of MLH1 and PMS2 in the tumor cells; Genetic analysis revealed MGMT methylation. Proton therapy was recommended given the elevated Ki67 index (75%) and p53 positivity. Before radiotherapy, there was no evidence of residual tumor or metastasis radiographically. He received 6600cGy of radiation over 33 fractions. Surveillance MRI showed recurrence at 21 months postoperatively, and temozolomide was initiated. However, MRI demonstrated marked progression after 3 cycles, and at 44 months, he developed a new 6th nerve palsy (Figure1c). Next-generation sequencing using the MSK-IMPACT platform identified somatic mutations in MLH1 Y548lfs*9 and TP53 R337C[4]. Immunotherapy with ipilimumab/nivolumab was initiated [5], and the patient noted resolution of his third nerve palsy soon after. MRI demonstrated a dramatic response with only minimal residual tumor burden (Figure1d). CONCLUSION: PC is a rare tumor with frequent recurrence and a short median expected length of survival. Here we demonstrate the utility of immunotherapy in a single case report of PC. This treatment helped our patient survive well beyond the expected median life expectancy of this aggressive disease.

BRMP-04. AI-BASED BIOMARKER OF THE PERITUMORAL REGION USING TISSUE MICROSTRUCTURE

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PURPOSE: Glioblastomas, the most common malignant brain tumor [BS1], infiltrate into peritumoral brain structures, making clinical management challenging. An unmet need is to develop a biomarker that reliably characterize infiltration in the peritumoral region, where surgical biopsy or resection may be hazardous. Diffusion tensor imaging (DTI) with multicompartment modeling can characterize extracellular free water, providing unique information of the tissue microstructure that is able to capture this heterogeneity. We propose a novel biomarker based on peritumoral tissue microstructure, using deep-learning on DTI-based free water map. METHOD: Peritumoral regions were automatically segmented for 136 patients with brain tumors (86 glioblastomas and 50 metastases, ages 23–87 years, 65 females). We trained a Convolutional Neural Network (CNN) on free-water maps using automatically defined patches in the peritumoral area from glioblastomas and metastases, labeled as low free-water and high free-water to extract a microstructural index for each voxel. To extract the biomarker, we grouped peritumoral voxels into connected components (CCs) where adjacent voxels have high (>0.9) microstructural index values. Two independent test sets related to two clinically significant problems were evaluated: i) metastases vs. glioblastomas; ii) glioma patients categorized into short and long survival groups and the number