function. In rare patients who undergo a repeat awake craniotomy, intraoperative mapping provides a unique opportunity to study cortical reorganization in the setting of disease.

METHODS: We examined a database of 561 brain tumor patients who underwent intraoperative language and sensorimotor mappings during awake craniotomies at our institution. We identified 19 patients who underwent repeat awake craniotomies in which the same brain areas were re-mapped using direct cortical stimulation. Each mapping was performed by the same surgeon and documented by hand-written diagrams, photographs and operative reports.

RESULTS: We compared intraoperative mapping results between initial and repeat craniotomies to determine if language, motor or sensory functions had reorganized between procedures. In 13 of 19 patients (68%), we observed no reorganization of functional areas. In the remaining 6 of 19 patients (32%), functional reorganization occurred. There was no significant difference in the mean inter-procedure intervals (1679 days vs 1543 days, respectively; $P = .75$), or mean ages (38.7 vs 39.4 years; $P = .89$) between these groups. In 3 of these 6 patients (50%), loss of function occurred, such that eloquent areas lost language or motor function between procedures. In the remaining 3 of these 6 patients (50%), gain of function occurred, such that non-functional areas developed language or motor function between procedures. We did not observe any case in which function shifted from one modality to another.

CONCLUSION: The adult central nervous system reorganizes motor and language areas in the setting of brain tumors. This surprising plasticity may allow for the preservation of language and sensorimotor function in disease states. In order to avoid causing functional deficits during re-operation, surgeons cannot rely on maps obtained from a previous craniotomy.

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Intraoperative Cerebral Glioma Characterization With Contrast Enhanced Ultrasound

Francesco Prada, MD; Luca Mattei, Assunta Filippini, Cecilia Casali, Federico G. Legnani, MD; Alessandro Moiraghi, Alessandro Perin, Carla Richetta, Ignazio G. Vetrano, MD; Francesco DiMeco, MD

INTRODUCTION: Contrast enhanced ultrasound (CEUS) is a dynamic and continuous modality that offers a real-time direct view of vascularization and flow distribution patterns of different organs and type of tumors. Nevertheless, its intraoperative use for brain tumors visualization has been performed few times, and there are no guidelines on this regard. Furthermore, a thorough characterization of cerebral glioma had never been performed. The main aim of the study is to describe the different patterns of enhancement of cerebral gliomas using the CEUS technique.

METHODS: We performed intraoperative CEUS (iCEUS) in an off-label setting in 69 patients undergoing surgery for cerebral glioma. Ultrasound contrast agent (UCA) (sulphur hexafluoride (SonoVue—Bracco—Italy)) was administered intravenously and the lesion scanned for at least 120 seconds. An on-site and a post-procedural semi-quantitative analysis was performed for each case, evaluating CEUS parameters, following the guidelines of the European Federation for Ultrasound in Medicine and Biology (EFSUMB): timing, degree of CE and contrast distribution.

RESULTS: Both low-grade glioma (LGG) and high-grade glioma (HGG) appear hyper-echoic relative to the adjacent brain parenchyma on B-mode US. Different contrast enhancement patterns were observed according to lesion characteristics: LGG showed a dotted or diffuse appearance with a slower and delayed arterial and venous phase compared with HGG, whereas HGG have a more nodular, non-homogeneous appearance, with faster and major contrast enhancement.

CONCLUSION: Our study characterizes for the first time, human brain glioma with iCEUS, giving us further insight regarding the biology of these tumors: being a dynamic and continuous modality it offers a real-time direct view of the tumor perfusion and of the afferent and efferent vessels. CEUS is a fast, safe, dynamic, real-time, economic tool that might be helpful during surgery in differentiating malignant and benign gliomas and refining the surgical strategy.

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5-Aminolevulinic Acid-Induced Protoporphyrin IX Fluorescence in Low-Grade Gliomas

Pablo A. Valdes, PhD; Valerie L. Jacobs, BS; Brent T. Harris, MD, PhD, FCAP; Brian Wilson, Frederic Leblond, Keith Paulsen, PhD; David W. Roberts, MD

INTRODUCTION: Fluorescence-guided resection using 5-amino-levulinic acid-induced protoporphyrin IX (ALA-PpIX) has shown promising results in high-grade gliomas. However, few studies have investigated the utility of ALA-PpIX in low-grade gliomas. We have previously shown significantly improved diagnostic performance in high-grade gliomas using a quantitative technique for fluorescence-guidance compared to state-of-the-art visible fluorescence imaging techniques. Here we present our initial experience using both visible, subjective fluorescence and quantitative fluorescence in low-grade gliomas.

METHODS: Twelve patients with a diagnosis of low-grade glioma were administered 20 mg/kg of ALA prior to surgery under an institutional Review Board approved protocol. Assessments of the visible, red fluorescence and quantitative measurements of PpIX concentrations (CPpIX) were obtained from multiple locations intraoperatively, and subsequently biopsy specimens underwent neuropathological analysis. Receiver operating characteristic (ROC) analysis to assess the diagnostic performance of both fluorescence guidance techniques was performed.

RESULTS: Five of 12 tumors demonstrated at least 1 instance of visible fluorescence. Normal tissue presented with a mean CPpIX = 51.0 ng/mL [min = 0.0, 25th-percentile = 1.0, 75th-percentile = 5.0, max = 567.0], while tumor had a mean CPpIX = 766.0 ng/mL [min = 0.0, 25th-percentile = 1.0, 75th-percentile = 177.0, max = 10540.0]. ROC analysis of visible fluorescence yielded a diagnostic accuracy of 38.0% (cut-off threshold = visible fluorescence score ≥1, AUC = 0.514), whereas quantitative fluorescence yielded a diagnostic accuracy of 67 % (for a cut-off threshold of CPpIX >5.6 ng/mL, AUC = 0.66). Further, 45% (9/20) of tumor specimens that were not visibly fluorescent, which would have otherwise gone undetected, accumulated diagnostically significant levels of CPpIX using quantitative fluorescence measurements.

CONCLUSION: This initial experience of ALA-PpIX in LGG concurs with the literature understanding that visible fluorescence results in poor diagnostic accuracies. We found diagnostically significant levels of CPpIX in LGGs that were non-visibly fluorescent and below the visible

fluorescence detection threshold. Further, in this initial experience using quantitative methods, we found that the diagnostic performance of ALA-PpIX in LGG approaches that of visible methods for high-grade gliomas.

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Seven-Year Update of Multicenter Prospective Study of Large Vestibular Schwannomas: Acoustic Neuroma Subtotal Resection Study

Ashkan Monfared, MD; Eduardo Corrales, MD; Philip V. Theodosopoulos, MD; Nikolas Blevins, John Steven Oghali, MD; Samuel H. Selesnick, Howard Lee, PhD; Richard Gurgel, MD; Marlan Hansen, MD; Rick F. Nelson, MD; Bruce Gantz, MD; Walter Kutz, Brandon Isaacson, Peter Roland, MD; Richard Amdur, Robert Jackler,

INTRODUCTION: Patients with large acoustic neuromas are at high risk of poor facial nerve (CNVII) function following surgery. Subtotal resection has the potential for better facial nerve outcome but higher tumor recurrence.

METHODS: Patients with acoustic neuromas = 2.5 cm underwent gross total (GTR), near total (NTR) with remnant tumor no larger than $0.5\ cm^3$ on postoperative magnetic resonance imaging (MRI) or $2 \times 2 \times 5$ mm residual in surgery, or subtotal (STR) resection defined as any larger remnant. Patients received stereotactic radiation if tumor remnant grew.

RESULTS: Of 132 enrolled patients, 73 had at least 1-year follow-up (mean 38 months). Average age was 48.7 years, mean tumor diameter was 3.33 cm, and 34% were cystic. As defined by postoperative MRI, 12 had GTR, 22 NTR, and 39 STR. There were 14 (21%) recurrences, 1 (8%) in GTR, 2 (9%) in NTR, and 11 (28%) in STR groups with average of 35 months to recurrence (4-74 months). The recurrences were treated with SRT in 11 cases, intensity-modulated radiation therapy in 1 case, and surgery in 2 cases due to size and cystic nature of recurrence. Four post-radiation remnants (33%) continued to grow and required surgical salvage. Tumor recurrence was related to longer follow-up, non-cystic tumor, larger residual tumor, and STR resection. Good facial nerve function (House-Brackmann I and II) was achieved in 67% immediately and 81% at 1-year from surgery. Better immediate but not late nerve function was associated with smaller preoperative tumor size and residual tumor left behind.

CONCLUSION: Less-than-total resection of large acoustic neuromas allows for excellent facial nerve outcomes; however, the rate of persistent growth is inversely proportional to the size of residual tumor. Growing tumor remnants may be treated effectively with stereotactic radiation, though about 1/3 of tumors may still require surgical salvage. The NTR group had slightly better CNVII outcome compared to GTR without increased risk of recurrence.

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Simvastatin in Aneurysmal Subarachnoid Haemorrhage (STASH) Trial: A Clinical Phase 111 Randomised Placebo Controlled Trial—The Results

Carole L. Turner, MSc; Christopher Smith; Gordon D. Murray, Peter J. Hutchinson, PhD, FRCS; Peter J. Kirkpatrick, FRCS

INTRODUCTION: Prevention of cerebral vasospasm is the target of modern drug therapy, candidates of which include statins. The results of phase 11 studies have shown promise in this arena. STASH is an international multicentre randomised controlled phase 111 trial designed to assess the effects of Simvastatin 40 mg on the long and short term outcome of patients who have suffered from an acute aneurysmal subarachnoid haemorrhage (SAH).

METHODS: All grades of SAH patients with a radiological proven aneurysm were eligible. Patients were randomized to receive Simvastatin 40 mg or placebo for up to 21 days. Primary outcome was the modified Rankin Disability Score (mRS) at 6 months. Secondary outcome measures included the SF-36 short form questionnaire at 6 months, the incidence and duration of delayed ischemic deficit (DID) and associated rescue therapy, the incidence and severity of sepsis, length of intensive care and total acute hospital stay, and discharge destination. Primary analysis was an ordinal regression of the mRS following the intention to treat (ITT) principle.

RESULTS: Eight hundred three patients (252 male, 551 female) were recruited with mean age 50 years (range 21 67). Six hundred seventy-six (85%) from UK centres and 127 (15%) from non-UK centres. Five hundred eighty-eight patients (73%) were WFNS grade 1-2 on admission and 84% had a CT scan Fisher Grade 3 or 4. Five hundred fifteen patients (64%) were coiled. 6 month outcome data is available for 782 (97%) of which 560 (72%) were mRS 0-2 at 6 months. DID was confirmed in 131 (16.3%), and the overall mortality at 6 months was 9% (n = 72). Mean length of hospital stay was 20 days and ITU stay 12 days. Four hundred seventy-one (59%) were discharged directly home and 102 (13%) were discharged to rehabilitation centres.

CONCLUSION: Primary outcome, secondary outcome measures and subgroup analyses will be presented from the ITT population.