

total resection of 5-ALA positive lesion, i-CT and postoperative MRI revealed 14 (78%) residual tumors. I-CT revealed 7 (50%) in all residual tumor. **DISCUSSION:** Hemorrhage, brain edema, air, invasive lesion, and limitation of resolution of CT might make difficult to detect residual tumor.

**CONCLUSION:** I-CT may be useful to detect residual tumor even with 5-ALA and improve resection rate.

#### STMO-04

##### LOCAL CONVECTION-ENHANCED DELIVERY OF CHEMOTHERAPY AS TREATMENT FOR BRAIN TUMORS

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**BACKGROUND:** Convection-enhanced delivery (CED) of therapeutic agents is a promising local delivery technique that has been extensively studied as a treatment for CNS diseases over the last 2 decades. Applying this technique to treat brain tumors, we have been working to develop novel local chemotherapy against brain tumors. In the meanwhile, clinical trial against diffuse intrinsic brain tumor aiming at Japanese “shonin” approval is recruiting patients. In this study, potential of local CED based chemotherapy against supratentorial brain tumor is discussed. **METHODS:** Until today, we have evaluated the safety and efficacy of local CED of nimustine hydrochloride against supratentorial malignant glioma patients in the three prospective, single institute, nonrandomized, open-label studies. Among those, one study recruited the recurrent malignant glioma patients whose enhanced tumor can be surgically resected. After the resection of the tumor, CED of ACNU was performed targeting the surrounding brain. Temozolomide was also given for 5 days during this trial. **RESULTS:** Seven patients; 4 male and 3 female, age 33–71 y.o. (median 54 y.o.), were treated in this study. Five patients suffered glioblastoma and two suffered anaplastic astrocytoma. After the treatment, all seven patients lived longer than a year; one survived three years, one survived four and a half years, and one with glioblastoma is still alive after 5 years. **DISCUSSION:** Potential efficacy of local chemotherapy delivering nimustine hydrochloride with CED against recurrent malignant glioma was suggested. Further study is required to pave the way for this strategy against supratentorial malignant gliomas.

#### STMO-05

##### SURGICAL AND FUNCTIONAL OUTCOME OF AWAKE SURGERY FOR INSULAR GLIOMA

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**BACKGROUND:** Insular glioma is still challenging entity for neurosurgeons because of its deep location and the surrounding vascular structures and eloquent white matter fibers. Objective. To clarify the surgical and neurofunctional outcome of awake surgery for patients with insular glioma (IG). **METHODS.** We conducted a retrospective review of 42 consecutive patients with insular glioma (IG) and non-insular glioma (non-IG) who underwent awake craniotomy. In addition to surgical outcome including operative complication, the detailed objective neurocognitive evaluation were also analyzed. **RESULTS:** Ten IG and 32 non-IG patients were included in this study. Preoperative tumor volume in IG group was smaller than non-IG group (15.3cc, 21.9cc,  $p=0.14$ ). More patients (8 in 12) in IG patients had tumor in the right hemisphere than non-IG group (12 out of 32,  $p=0.06$ ). All the resection were performed according to the functional boundary decided by the cortical and subcortical mapping. Preoperatively, IG patients showed better cognitive function in the TMT-B and categorical fluency test ( $p=0.035$ ,  $p=0.026$ , respectively). Postoperatively, the median residual volume and the resection rate in IG and non-IG group were 2.2cc vs 0cc ( $p=0.10$ ) and 85.5% vs 100% ( $p=0.025$ ) respectively, suggesting better resection in non-IG group. In terms of complications, 2 patients (20%) in IG group showed infarction in acute postoperative MR images and mild hemiparesis which recovered completely at 3-month evaluation after operation. In contrast, 16 out of 32 non-IG patients (50%) demonstrated new impaired neurocognitive function, which still persisted at final follow-up in 9 out of 16. Most of their postoperative MR images showed no ischemic lesion, suggesting white matter disconnection as main cause of new deficits. More non-IG patients demonstrated the prolonged time in TMT-A than IG patients at 3-month evaluation. **CONCLUSION:** Subcortical white matter disconnection, not ischemic change, are the main reason of postoperative neurocognitive dysfunction in non-IG patients.

#### STMO-06

##### SMART CYBER OPERATING THEATER REALIZED BY INTERNET OF THINGS - RESULTS OF CLINICAL STUDY FOR 56 CASES -

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**PURPOSE:** Unlike conventional operating rooms that provide a sterilized space, we have developed a Smart Cyber Operating Theater (SCOT) in which the room itself performs treatment as a single medical device. We report the clinical results of 3 types of SCOT. **METHODS:** Basic SCOT packaged with intraoperative MRI (0.4Tesla) was introduced in Hiroshima University in 2016. Standard SCOT networked with middleware OPeLiNK was introduced to Shinshu University in 2018, and Hyper SCOT introduced to Tokyo Women's Medical University in 2019. **RESULTS:** The average of all 56 patients was 44 years old. There were 38 brain tumors (68%), 11 functional diseases (19%), and 7 orthopedic diseases (13%). Basic SCOT is used for 41 cases (56; 73%) with 22 gliomas, 10 epilepsies, 7 bone tumors, and 2 benign brain tumors. Standard SCOT with 20 networked devices is used for 14 cases (56; 25%) with 6 gliomas including brain stem and thalamus, 6 pituitary tumors and 2 benign brain tumors. The strategy desk can display a variety of digital data synchronized in time, and the review and comment functions also operate. It is useful for remote advice through mutual communication via strategy desk. Hyper SCOT was used in February 2019 for the first case (1/56 cases; 2%). MRI images were taken with an average of 1.3 shots with good image quality. For 46/56 neoplastic lesions (82%), additional removal of residual tumor was performed in 31/46 cases (67%), and 26/46 cases (57%) were totally removed, with an average removal rate of 89.2%. There was no reoperation (0%) within 1 month in all cases. **CONCLUSIONS:** Three types of SCOT contributed to planned surgical outcome including maximal tumor resection without serious related complications. We will proceed with verification of clinical effects, and develop robotized devices, and utilize AI for strategy desk at Hyper SCOT.

#### STMO-08

##### INFLUENCE OF WIDE OPENING OF THE LATERAL VENTRICLE ON SURVIVAL FOR SUPRATENTORIAL GLIOBLASTOMA PATIENTS WITH RADIOTHERAPY AND CONCOMITANT TEMOZOLOMIDE-BASED CHEMOTHERAPY

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**BACKGROUND:** The prognosis for glioblastoma (GBM) varies among patients. Ventricular opening during surgery has been reported as a prognostic factor for GBM patients, but the influence of ventricular opening itself on patient prognosis remains controversial. **OBJECTIVE:** Accumulating evidence has suggested that the subventricular zone (SVZ) harbors a neural stem cell niche and is associated with gliomagenesis. Several reports have hypothesized that aggressive characteristics of GBM in contact with the SVZ may be associated with the recruitment of neural stem cells from the SVZ that have abilities associated with invasive proliferation, leading to poor prognosis. We presumed that the degree of ventricular opening would correlate with the degree of SVZ resection and with prognosis in GBM patients. This study therefore investigated whether the degree of ventricular opening correlates with prognosis in GBM patients treated with the standard protocol of chemo-radiotherapy. **METHODS:** Participants comprised 111 patients with newly diagnosed GBM who underwent surgery and postoperative radiotherapy and TMZ-based chemotherapy from 2005 to 2018. We classified 111 patients into “No ventricular opening” (NVO), “Ventricular opening, small” (VOS; distance < 21 mm) and “Ventricular opening, wide” (VOW; distance > 21 mm) groups. We evaluated the relationship between degree of ventricular opening and prognosis using survival analyses that included other clinicopathological factors. **RESULTS:** Log-rank testing revealed age, KPS, extent of resection, MGMT status, IDH1 mutation, and degree of ventricular opening correlated significantly with overall survival. Multivariate analysis identified the degree of ventricular opening (small vs. wide) as the most significant prognostic factor (hazard ratio = 3.674;  $p < 0.0001$ ). **CONCLUSIONS:** We demonstrated that wide opening of the lateral ventricle (LV) contributes to longer survival compared with small opening among GBM patients. Our results indicate that wide opening of the LV may correlate with the removal of a larger proportion of tumor stem cells from the SVZ.

#### STMO-10

##### SURGICAL RESECTION FOR PRIMARY MOTOR CORTEX GLIOMA, TWO CASE REPORTS

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Primary motor cortex glioma is usually considered unresectable because of its high risk for motor deficit. However recent reports suggest that surgical resections for primary motor cortex brain tumor is feasible for selected patients. In this case report, we report two cases we can successfully resected primary motor cortex glioma by awake surgery without neurological worsening.

Case1 was 32 year-old woman with right primary motor cortex oligodendroglioma. We could only perform biopsy at initial surgery, however the patient got worsening of left hemiparesis which were gradually improved by rehabilitation. The patient underwent 50 Gy of radiation therapy and 6 courses of PCV chemotherapy. 60 months after the initial surgery, the tumor recurred and the she underwent 12 courses of temozolomide chemotherapy, but tumor continued to grow. She underwent second surgery 13 years after the initial biopsy. We resected primary motor cortex tumor by awake surgery without neurological complication.

Case2 was 31 year-old woman with left primary motor cortex oligodendroglioma. We could only perform biopsy at initial surgery, however the patient got mild right hemiparesis which were improved by rehabilitation. The patient underwent 4 courses of PAV chemotherapy and 54 Gy of Intensity Modulated Radiation Therapy (IMRT). 21 months after IMRT, the tumor recurred and the she underwent second surgery. We resected primary motor cortex tumor by awake motor mapping without severe neurological complication.

In conclusion, surgical resections for primary motor cortex glioma is feasible in selected patients without severe neurological complication. Neural plasticity is the reason for this, but careful intraoperative awake mapping is necessary to achieve maximum resections.

#### STMO-11

##### CLINICAL EFFICACY OF AWAKE SURGERY: ANALYSIS OF 335 CASE ON EXTENT OF RESECTION AND SURVIVAL TIME

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**INTRODUCTION:** Awake craniotomy (AS) with intraoperative mapping can be compatible to obtain maximal resection and preserve neurological function for glioma surgery. However, there is less evidence to improve overall survival for glioma patients. We compared the long-term outcome of glioma resection during AS and general anesthesia (GA). **METHODS:** Continuous 335 patients with newly diagnosed glioma of WHO grade2 (G2) or higher who underwent surgery with intraoperative MRI between 2000 and 2013 were reviewed. Three-dimensional volumetric tumor measurements before and after operation were made. Multivariate analysis was used to evaluate the effect of awake surgery on overall survival (OS). **RESULTS:** The mean age of all cases was 46 years, male: female 199: 136, mean preoperative tumor volume (PTV) 44.5cc, mean extent of resection (EOR) 88.31%, and median survival (MST) 82.6 months. MST of G4 was significantly longer in the AS group (AS 38.9 months vs. GA group 22.0 months:  $p = 0.03$ ), while multivariate analysis showed that age and KPS was a significant prognostic factor, but AS was not. There was no significant difference in the EOR of G3 (AS group 80.1% vs. general anesthesia 84.2%:  $p = 0.365$ ), and MST was also not significantly different (AS group 134.8 months vs. GA group 117.9 months:  $p = 0.338$ ). G2 also had no significant difference in the EOR (AS group 84.6% vs. GA group 86.7%:  $p = 0.92$ ), and MST was also not significantly different (AS group 152.9 months vs. GA group 135.1 months:  $p = 0.235$ ). Analysis of G2 or G3 showed no significant differences in PTV, KPS, and age at the surgery between two groups. **CONCLUSION:** Even if a glioma is located close to or within the eloquent area, AS can lead to EOR and OS equivalent to the removal of the non-eloquent area under GA.

#### STMO-14

##### SURGICAL MANAGEMENT OF DEEP-SEATED GLIOMA AROUND THALAMUS

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**BACKGROUND:** Higher extent of resection contributes to better prognosis of the patients with glioma. However, resection of deep-seated glioma represents a surgical challenge not only because of the depth but because of adjacent eloquent structures such as pyramidal tract, deep venous system, and brainstem. **METHODS:** We performed a retrospective review of patients with deep-seated glioma around thalamus who underwent surgery between March 2014 and February 2019. The tumors were removed with use of neuronavigation, DTI tractography, electrophysiological monitoring and

photo dynamics diagnosis using aminolevulinic acid via interhemispheric or transcortical approach. Volumetric analysis of preoperative tumor volume as well as postoperative residual volumes was performed. **RESULTS:** A total of 17 patients, ages ranged from 13–79 years (median; 51) were eligible. Twelve patients underwent radical resection and 5 underwent biopsy (2 with craniotomy, 2 with endoscopy, and 1 stereotactic biopsy). Pathological diagnosis consisted of glioblastoma (GBM) in 10, diffuse midline glioma (DMG) in 3, anaplastic astrocytoma in 3, and diffuse astrocytoma in 1. Extent of resection of the patients attempted radical resection was  $96.7\% \pm 6.4\%$ . Postoperatively, 12 patients developed hemianopsia, 2 had hemiparesis because of corticospinal tract injury, 2 sensory disturbance, and 3 cognitive dysfunction. At 1 month after surgery, Karnofsky performance status (KPS) worsened in 5 GBM patients and 1 DMG patient, while improved or stable in the rest 11 patients. **CONCLUSION:** Resection of deep-seated glioma around thalamus accompanies a high risk of neurological deficits. Nevertheless, radical resection without KPS decline can be achieved by preserving the corticospinal tract, deep venous system, and brainstem and minimizing damages of surrounding brain.

#### STMO-15

##### OUR THERAPEUTIC STRATEGIES FOR GLIOBLASTOMA: INTRAOPERATIVE SUPPORT SYSTEMS [INTRAOPERATIVE MRI, PET, 5-AMINOLEVULINIC ACID (5-ALA)] AND NEOADJUVANT CHEMOTHERAPY

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**OBJECTIVE:** Neuronavigation systems with MRI and multiple PET examinations (methionine [MET], fluorothymidine [FLT], and fluoromisonidazole [FMISO]) have become our standard techniques for glioma surgeries. Residual tumors are identified and removed using intraoperative MRI (IoMRI) to maximize tumor removal. This time, we performed tumor removal after Bevacizumab (Bev) therapy for glioblastoma with low KPS at admission and compared extraction rate and residual volume of MRI and PET examinations, and prognosis between with and without Bev therapy. **METHODS:** We selected 12 glioblastoma patients with low KPS at admission and performed multiple PET examinations and IoMRI from January 2016 to July 2019. We divided them into the pre-Bev group that performed tumor removal after neoadjuvant Bev therapy and the non-Bev group that did not use Bev. We compared the extraction rate and residual volume of MRI and PET examinations, and prognosis between the pre-Bev group and the non-Bev group. **RESULTS:** The pre-Bev group was 6 cases and the non-Bev group was 6 cases. The number of KPS for the pre-Bev group just before surgery was (90; 3 cases, 80; 2 cases, 70; 1 case) and (50; 2 cases, 40; 4 cases) for the non-Bev group. For comparison between the pre-Bev group and the non-Bev group, the extraction rate (%) was T1-Gd (97.6, 91.5), MET (95.4, 99.9), FLT (96.2, 90.2), FMISO (97, 92), residual volume (ml) was T1-Gd (0.6, 1.7), MET (1.2, 2.9), FLT (1.0, 2.1), FMISO (0.5, 1.1), and for prognosis, median PFS (month) is (10.1, 4.9) and median OS (months) was (15.7, 13.3). **CONCLUSIONS:** For glioblastoma patients with low KPS at admission, the neoadjuvant Bev therapy improved KPS just before surgery. The neoadjuvant Bev therapy improved the extraction rate and reduced residual volume of MRI and PET examinations and leads to the prolonged prognosis of PFS and OS.

#### STMO-18

##### SUBPIAL RESECTION OF GLIOMA USING CUSA CLARITY

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**BACKGROUND:** Maximum safe resection is a primary goal of glioma surgery. Ultrasonic aspiration is commonly used technique in neurosurgery, as it allows for safely debulking of tumors without damaging the adjacent brain tissue. CUSA Clarity helps to avoid damage to blood vessels and nerve fibers due to its original function, 'Tissue Select'. Here we introduce glioma surgery using CUSA Clarity. **METHODS:** We used CUSA Clarity in three cases with glioma at Kyorin University Hospital. According to fragility of the tissues and hardness of the tumor, we adjusted power, irrigation, and Tissue Select level of CUSA Clarity. We also introduce subpial aspiration technique in glioma surgery using normal CUSA. **RESULTS:** Histological diagnoses of the three patients were WHO grade IV glioblastoma, grade III anaplastic astrocytoma, and grade II oligodendroglioma. All patients underwent successful maximum safe resection without ischemic complication. CUSA Clarity allowed for safe subpial dissection and preservation of pia and small vessels more perfectly than surgery using normal CUSA. CUSA Clarity also contributed to bloodless dissection of the tumor margin due to