

modulus. Magnetic resonance elastography (MRE) is an epoch-making method capable of non-invasively imaging the elasticity of internal organs. We have examined the elasticity of meningiomas and pituitary adenomas and reported their usefulness. This time, we measured the glioma elasticity and verified usefulness of MRE.

METHOD: Twenty-four gliomas (mean age 51.8±15.7 years, male: female = 17: 7) who underwent tumor resection after MRE imaging from July 2017 to May 2020 were targeted. The average elasticity was measured as an evaluation of tumor elastic modulus by MRE. Gliomas were divided into a low-grade glioma group (LGG: Grade 1, 2) and a high-grade glioma group (HGG: Grade 3, 4). Then, a comparative statistical study was conducted.

RESULTS: The average values of the average elasticity of LGG group (9 cases) and HGG group (15 cases) were 1.8±0.8 kPa and 2.5±0.8 kPa, respectively. The average elasticity was significantly higher in the HGG group ($p=0.023$). In the ROC analysis, the cutoff value was 2.1 kPa (sensitivity 70%, specificity 70%). Therefore, it was suggested that the tumor is likely to be HGG when the average elasticity is 2.1 kPa or more.

DISCUSSION: The glioma elasticity by preoperative MRE was significantly higher in the HGG group. Based on actual surgical experience, the tumor seems to be hard in the HGG group, and it was judged to be consistent with this our MRE research. The preoperative evaluation of glioma elasticity by MRE was considered useful, and it might help in planning a surgical strategy considering malignant grade.

NI-04

EVALUATION OF POST BORON NEUTRON CAPTURE THERAPY FOR RECURRENT MENINGIOMA USING FLUORIDE-LABELED BORONOPHENYLALANINE PET

Satoshi Takai¹, Yoko Matsushita³, Shinji Kawabata¹, Koji Ono², Kayako Isohashi², Masahiko Wanibuchi¹, Shinichi Miyatake²; ¹Osaka medical college hospital, Osaka prefecture, Japan

We have applied boron neutron capture therapy (BNCT) for 46 recurrent high grade meningiomas (HGM). Twelve cases among them, fluoride-labeled boronophenylalanine positron emission tomography (18F-BPA-PET) were utilized before and after BNCT to evaluate the tumor activity. The lesion to normal brain (L/N) ratios of 14 lesions of these 11 cases were investigated. In all cases L/N ratio decreased after BNCT. The L/N ratio of recurrent (HGM) was 3.2±1.5 (mean±SD) before BNCT and 2.1±0.6 after that. In contrast enhanced MRI, 13 out of 14 lesions shrank or unchanged at least 3 months after BNCT, while one lesion transiently increased and then decreased within 3 months, showing pseudoprogression. In addition, 6 of 12 lesions which could be followed on MRI for more than 3 months progressed after 8 months. 4 of them were performed PET at the time of progressing. The L/N ratio of 2 progressing lesion which were diagnosed as recurrence due to continuously increasing were showed increasing. The L/N ratio of the other 2 lesions which were diagnosed radiation necrosis due to unchanged or shrinkage showed decreasing. Moreover, some systemic metastasis detected in PET image. F-BPA-PET seems to be useful for the evaluation of tumor activity.

NI-08

UTILITY OF MULTIPLE POSITRON EMISSION TOMOGRAPHY TRACERS IN THE DIAGNOSIS OF BRAIN TUMORS ACCORDING TO THE 2016 WORLD HEALTH ORGANIZATION CLASSIFICATION
Keisuke Miyake¹, Takeshi Fujimori¹, Yasunori Toyota¹, Daisuke Ogawa¹, Tetsuhiro Hatakeyama¹, Masanobu Okouchi¹, Masahiko Kawanishi¹, Takashi Tamiya¹; ¹Department of Neurological Surgery, Kagawa University Faculty of Medicine, Kagawa, Japan

OBJECTIVE: Magnetic resonance imaging alone is not sufficient for the diagnosis and therapy outcomes in brain tumors. We herein examined the utility of positron emission tomography (PET) studies for diagnosis in brain tumors. **METHODS:** Between April 2009 and June 2020, 320 patients with central nervous diseases, including 140, 65, 52, 52, and 11 patients with glioma, metastatic brain tumor, malignant lymphoma, meningioma, and demyelinating disease, respectively, underwent PET studies (FDG, MET, FLT, and FMISO) in our department. Lesion/normal (L/N) ratios for FDG, MET, and FLT and lesion/blood ratio (L/B ratio) for FMISO were compared. The glioma subtypes were compared based on the 2016 World Health Organization classification (IDH-mut, Codell, IDH-wt, GBM), and metastatic brain tumors, malignant lymphomas, meningiomas, and demyelinating diseases were compared with GBM. **RESULTS:** In glioma, the cutoff MET L/N ratios to distinguish between IDH-mut and Codell, IDH-mut and GBM, Codell and GBM, and IDH-wt and GBM were 3.61, 4.42, 4.92, and 4.33, respectively, and the cutoff FLT L/N ratios to distinguish between IDH-mut and IDH-wt, IDH-mut and GBM, Codell and GBM, and IDH-wt and GBM were 3.43, 6.46, 3.39, and 7.56, respectively. The cutoff FDG and MET L/N ratios between metastatic brain tumors and GBM were 2.27 and 4.89; the cutoff FDG L/N and FMISO L/B ratios between malignant lymphoma and GBM were 4.68 and 2.13; and the cutoff FDG and MET L/N ratios between

meningioma and GBM were 1.58 and 4.36. Demyelinating disease and GBM were distinguishable by FDG, MET, and FLT L/N ratios of 2.29, 3.32, and 5.85, and FMISO L/B ratio of 1.68. **CONCLUSION:** Four PET tracers were required to differentiate glioma subtypes. FDG and MET are useful for distinguishing GBM from metastatic brain tumor, malignant lymphoma, and meningioma, whereas accumulation was lower for all four PET tracers in demyelinating diseases than in GBM.

NI-09

AMIDE PROTON TRANSFER (APT) IMAGE IS USEFUL FOR DIAGNOSTIC IMAGING OF GLIOMA

Masami Shiota¹, Masayuki Nitta², Taiichi Saitou², Syunsuke Tuduki², Atsushi Fukui², Souko Ikuta³, Ayako Yoshida⁴, Kayoko Abe⁵, Yoshihiro Muragaki^{2,3}, Takakazu Kawamata²; ¹Tokyo Women's Medical University Yachiyo Medical Center

INTRODUCTION: APT image (APT), which images the concentration of amide groups that increases in tumors, is expected to be applied clinically in diagnostic imaging of glioma. **PURPOSE:** APT was compared with MET-PET based on the pathological diagnosis results, and it was retrospectively verified that APT was useful for diagnostic imaging of glioma. **METHODS:** A total of 46 cases with glioma (WHO 2016 Grade: GII/III/IV) and Pseudoprogression were included. APT measured the APT measurement value by placing the region of interest in the tumor part. MET-PET was administered with 370MBq and the accumulation ratio (TNR) between the tumor part and the normal part was measured. **RESULTS:** The APT measurement value in all cases was 2.22±1.01 and the TNR was 2.58±1.50, and a correlation was observed between the APT measurement value and the TNR ($r=0.6$, $p<0.001$). When the accuracy of discrimination between GII/III/IV (32 cases) and Pseudoprogression (14 cases) by APT measurement was verified, the sensitivity was 91% and the specificity was 100% at the threshold of 1.81. In the verification of malignancy diagnosis, the measured APT value of GII (6 cases) was 2.18±0.43, the measured APT value of GIII (11 cases) was 2.67±0.69, and the measured APT value of GIV (15 cases) was 2.99±0.61. The measured value showed a significant difference. The measured APT value in the oligodendroglioma group (GII/III: 10 cases) was 2.37±0.66, the TNR was 3.52±1.41, and the measured APT value in the astrocytoma group (GII/III: 7 cases) was 2.67±0.45 and TNR was 2.41±0.87. In the oligodendroglioma group, the measured APT value was lower and the TNR was higher than in the astrocytoma group. **CONCLUSION:** It was suggested that APT may have the same diagnostic ability as MET-PET in diagnosing malignant tumors and distinguishing between recurrence and Pseudoprogression. Patients with an actual APT of 1.81 or higher should consider treatment strategies, and follow-up may be an option for patients with an APT of <1.81. APT, which is not affected by the blood-brain barrier, has little variation in measured values and is considered to be useful for diagnostic imaging of glioma.

NI-10

T2/FLAIR MISMATCH SIGN AND METHIONINE PET UPTAKE IN GRADE II AND III GLIOMAS

Yusuke Ebiko^{1,3}, Kaoru Tamura¹, Shoko Hara¹, Motoki Inaji^{1,2}, Yoji Tanaka¹, Tadashi Nariai^{1,2}, Kenji Ishii², Taketoshi Maehara¹; ¹Department of Neurosurgery, University of Tokyo Medical and Dental University, Tokyo, Japan

BACKGROUND: Recent study suggests that "T2/FLAIR mismatch" sign is specific MRI finding for isocitrate dehydrogenase mutated (*IDH*-mut) 1p19q non-codeleted gliomas (Grade II and III astrocytic tumors). T2/FLAIR mismatch sign may be useful for predicting the histological type of glioma before surgery. However, it is not known what this finding reflects. Therefore, we examined the correlation between T2/FLAIR mismatch sign and uptake of methionine with positron emission tomography (MET-PET), and molecular classification of glioma.

METHODS: 74 glioma patients (grade II: 30 cases, grade III: 44 cases) with preoperative MRI and MET-PET who underwent surgical resection during 2000–2019 were included in this study. MR scans were evaluated by 3 independent reviewers to assess presence/absence of T2/FLAIR mismatch sign. The tumor-to-normal (T/N) ratio of methionine uptake was calculated by dividing the maximum standardized uptake value (SUV) for the tumor by the mean SUV of the normal brain. We examined the relationship between *IDH* mutation, 1p19q codeletion, mismatch, and T/N ratio of MET-PET.

RESULTS: Out of the 74 cases, astrocytic tumors (A group: *IDH*-mutant, 1p19q non-codeleted) were 21 (28%), oligodendroglioma tumors (O group: *IDH*-mutant, 1p19q codeleted) were 19 (26%), and *IDH* wild tumors (W group) were 34 (46%). The T2/FLAIR mismatch sign was present in 16 cases (22%). The T/N ratio of MET-PET in the tumor with T2/FLAIR mismatch sign was 1.56, which was significantly lower than that in the tumor without mismatch sign (2.01, $p=0.016$). T2/FLAIR mismatch sign was found in 7 (33%)

cases in the A group, 0 (0%) case in the O group and 9 (26%) cases in the W group, and the positive rate was significantly higher in the A group ($p=0.013$).

CONCLUSIONS: “T2/FLAIR mismatch” sign was a specific finding for astrocytic tumor, and the cases with positive “T2/FLAIR mismatch” sign had significantly lower MET-PET uptake than that with negative cases.

NI-11

CLINICAL SIGNIFICANCE OF INTRACYSTIC DIFFUSION HYPERINTENSITY LESIONS REMAINING AFTER TREATMENT OF INTRACRANIAL GERM CELL TUMOR

Motoki Takano¹, Takeshi Takayasu¹, Ushio Yonezawa¹, Akira Taguchi¹, Kazuhiko Sugiyama², Fumiyuki Yamasaki¹; ¹Department of Neurosurgery, Graduate School of Biomedical and Health Sciences, Hiroshima University

BACKGROUND AND PURPOSE: About 30% of intracranial germ cell tumors are mixed germ cell tumors and teratomas are often found as those components. Intense chemoradiotherapy is performed according to the malignancy of the histopathology, but high-intensity lesion inside the cystic tumor on diffusion weighted imaging (DWI) sometimes remains after completion of the chemoradiotherapy. In this study, we examined the clinical significance of the DWI high-intensity lesion remaining in the cyst. **METHODS:** Five patients after initial chemoradiotherapy were resected residual tumor by craniotomy at our hospital from 2009 to 2019. Preoperative gadolinium-enhanced MRI defined the non-contrast-enhanced part of the tumor as intracystic, and DWI intensity was classified by its look as low-intensity, equal-intensity, and high-intensity compared to the cortex of the same slice. DWI signals in the solid area, cyst wall, and cyst were evaluated. **RESULTS:** All cases were mature teratoma in histopathology, and no other tumor components were observed. On DWI, the cyst wall and solid part were visualized with low signal. High-intensity lesions and equal-intensity lesions in the cyst cavity were found in 3 and 1 cases, respectively. In these cases, pathological findings revealed a keratin-like substance in the cyst. **DISCUSSION:** The intracystic high and equal intensity lesions on DWI removed after completion of chemoradiotherapy are considered to reflect the keratin-like component of mature teratoma. If DWI high intensity and equal intensity lesions remain in the cyst of the tumor after the completion of chemoradiotherapy, tumor shrinkage cannot be expected even if the chemotherapy is strengthened. In such cases, we should consider to removing them by surgery. **CONCLUSION:** When DWI high and equal intensity lesions are found in the cysts of tumors remaining after chemoradiotherapy for intracranial germ tumors, it is possible that mature teratoma remains.

NI-13

THE EFFECTIVENESS AND LIMITATION OF SURVIVAL PREDICTION IN PRIMARY GLIOBLASTOMA USING MACHINE LEARNING-BASED TEXTURE ANALYSIS

Toru Umehara^{1,2,12}, Manabu Kinoshita^{1,3,12}, Takahiro Sasaki^{4,12}, Hideyuki Arita^{1,5,12}, Ema Yoshioka^{6,12}, Tomoko Shofuda^{6,12}, Yoshinori Kodama^{7,12}, Ryuichi Hirayama^{1,12}, Noriyuki Kijima^{1,12}, Naoki Kagawa^{1,12}, Yoshiko Okita^{3,8,12}, Koji Takano^{8,12}, Takehiro Uda^{9,12}, Junya Fukai^{4,12}, Daisuke Sakamoto^{10,12}, Kanji Mori^{10,11,12}, Yonehiro Kanemura^{6,8,12}; ¹Department of Neurosurgery, Osaka University Graduate School of Medicine, Osaka, Japan

INTRODUCTION: Clinical application of survival prediction of primary glioblastoma (pGBM) using preoperative images remains challenging due to a lack of robustness and standardization of the method. This research focused on validating a machine learning-based texture analysis model for this purpose using internal and external cohorts. **METHOD:** We included all cases of IDH wild-type pGBM available of preoperative MRI (T1WI, T2WI, and Gd-T1WI) from the databases of Kansai Molecular Diagnosis Network for CNS tumors (KN) and The Cancer Genome Atlas (TCGA). Of 242 cases from KN, we assigned 137 cases as a training dataset (D1), and the remaining 105 cases as an internal validation dataset (D2). Furthermore, we extracted 96 cases from TCGA as an external validation dataset (D3). Preoperative MRI scans were semi-quantitatively analyzed, leading to the acquisition of 489 texture features as explanatory variables. Dichotomous overall survival (OS) with a 16.6 months cutoff was regarded as the response variable (short/long OS). We employed Lasso regression for feature selection, and a survival prediction model constructed for D1 via cross-validation (M1) was applied to D2 and D3 to ensure the model robustness. **RESULTS:** The population of predicted short OS by M1 significantly showed poorer prognosis in D2 (median OS 11.1 vs. 19.4 months; log-rank test, $p=0.03$), while there was no significant difference in D3 (median OS 14.2 vs. 11.9 months; $p=0.61$). In the comparative analysis using t-SNE, there was little variation in the feature distribution among three datasets. **CONCLUSION:** We were able to validate the prediction model in the internal but not in the external cohort. The presented result supports the use of machine learning-based texture analysis for survival prediction of pGBM in a localized population or country. However, further consideration is required to achieve a universal prediction model for pGBM, irrespective of regional difference.

NI-17

EVALUATION OF PREOPERATIVE APPARENT DIFFUSION COEFFICIENT (ADC) OF PERITUMORAL FLAIR HIGH LESION AND HISTOPATHOLOGICAL FEATURES IN PATIENTS WITH GLIOBLASTOMA

Kenichiro Matsuda¹, Rintaro Oe², Yukihiko Sonoda¹; ¹Department of Neurosurgery, Faculty of Medicine, Yamagata University, Yamagata, Japan

OBJECTIVE: In removal of the glioblastoma, maximum and safe removal is desired for recurrence prevention with functional preservation. In recent years, the setting of the removal range has also been studied not only the contrast enhanced lesions, but also the surrounding FLAIR high signal lesion. We are studying the prediction of the site that is likely to occur recurrence in the FLAIR high signal lesion of glioblastoma, and we are focusing on the ADC of pre-operative MRI as an index. The purpose of this study is to evaluate the ADC and the actual pathological tissue image in the FAIR high signal lesion around the contrast enhanced lesion of glioblastoma. **METHOD:** We examined the case of removal of the glioblastoma treated in our department. Analysis was performed using a pathological tissue specimen of excised tumors and their surrounding tissues in each case, and the ADC value of pre-operative MRI. Pathological tissue image and ADC values of FAIR high signal lesion were compared. **RESULTS:** 19 tissue samples which were taken from the FLAIR high signal lesion around the contrast enhanced tumor from 10 cases. For a total of 19 locations, it was compared with the histopathological features of the site. As a result, in the low part of the ADC value in the preoperative MRI relatively had high cell density of atypical cells, it was often exhibited findings that infiltration of tumor cells is suspected. **CONCLUSION:** In general, ADC is said to suggest an increase in cell density and thus infiltration of tumor cells. However, the same findings were obtained in the pre-operative MRI examined this time. Since ADC also suggests cell density and tumor infiltration in pre-operative MRI, ADC of pre-operative MRI was considered useful for examination of the removal range and radiation therapy planning in surgery for glioblastoma.

NI-19

USE OF ¹¹C-METHIONINE PET FOR DECISION OF DISCONTINUATION OF ADJUVANT CHEMOTHERAPY WITH TEMOZOLOMIDE

Takaaki Beppu¹, Yuichi Sato¹, Toshiaki Sasaki², Kazunori Terasaki², Kuniaki Ogasawara¹; ¹Department of Neurosurgery, Iwate Medical University, Iwate, Japan

BACKGROUND: The aim was to clarify whether positron emission tomography with ¹¹C-methyl-L-methionine (met-PET) is useful to decide on discontinuation of TMZ-adjuvant therapy in patients with residual diffuse astrocytic tumor. **METHODS:** Subjects were 44 patients with residual tumor comprising 17 with IDH1-mutant diffuse astrocytoma (DA), 13 with IDH1-mutant anaplastic astrocytoma (AA), and 14 with IDH1-wild glioblastoma (GB). All patients received TMZ-adjuvant chemotherapy (median, 12 courses), and whether to discontinue or continue TMZ-adjuvant chemotherapy was decided on the basis of the tumor-to-normal ratio in standardized uptake value from met-PET (T/N); patients with T/N < 1.6 immediately discontinued TMZ, and patients with T/N > 1.6 were either to continue or discontinued TMZ. Progression-free survival (PFS) was compared between patients with T/N > 1.6 and T/N < 1.6 in each tumor type. Median observation period was 434 days after met-PET scanning. **RESULTS:** The number of patient who underwent recurrence was 10 in DA, 7 in AA, and 11 in GB. All patients showing T/N > 1.6 underwent tumor recurrence. PFS was significantly longer in patients with T/N < 1.6 than T/N > 1.6 in DA and AA ($p < 0.01$ in both types), but was no significant difference between 2 groups in GB ($p = 0.06$). Sixteen of 17 patients (94%) in DA and AA showed recurrence from residual tumor, whereas 4 of 11 patients (36%) in GB showed recurrent tumor at remote regions which were different from residual tumor. **CONCLUSIONS:** The present study suggested that met-PET is beneficial to decide to discontinue adjuvant chemotherapy with TMZ in patients with residual tumors of DA and AA, but not useful for patients with GB. Reasons for unsuccessful results in GB might have been small sample size, failure of establishing the cut off value in T/N, recurrences at remote regions where not be assessed by met-PET.

NEURO-COGNITIVE FUNCTION/QOL/PATIENT CARE/PALLIATIVE CARE (NQPC)

NQPC-02

LONG-TERM SURVIVAL IN PATIENTS WITH PRIMARY INTRACRANIAL GERM CELL TUMORS TREATED WITH SURGERY, PLATINUM-BASED CHEMOTHERAPY, AND RADIOTHERAPY: A SINGLE-INSTITUTION STUDY

Kazuya Motomura¹, Hiroyuki Shimizu¹, Fumiharu Ohka¹, Kosuke Aoki¹, Kuniaki Tanahashi¹, Masaki Hirano¹, Lushun Chalise¹,