Abstracts

- Abstracts

NEURO-ONCOLOGY ADVANCES

**NI-13**

**PREDICTION OF PROGNOSIS IN NEWLY DIAGNOSED GliOBLASTOMA USING MACHINE LEARNING-BASED TEXTURE ANALYSIS FROM PREOPERATIVE MRI**

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**INTRODUCTION:** Preoperative magnetic resonance imaging (MRI) is a critical modality for the determination of glioblastoma (GBM) treatment strategy, as it is thought to reflect the biology of the tumor to some extent. The authors attempted to predict prognosis of newly diagnosed GBM (nGBM) using machine learning-based texture analysis of preoperative MRI. MATERIALS AND METHODS: A total of 160 nGBMs with determined overall survival were collected from Kansai Molecular Diagnosis Network for CNS tumors. Preoperative MRI scans (T1WI, T2WI, and Gd-T1WI) from all cases were semi-quantitatively analyzed leading to acquisition of 489 texture features as explanatory variables using Matlab-based in-house software. Dichotomous overall survival (OS) with cutoff of 15 months was regarded as the response variable (short or long OS). Lasso regression was employed for feature selection to ensure robustness of the prediction model. One hundred patients were randomly assigned as training dataset (TR), followed by predictive model construction via 5-fold cross-validation. Subsequently, the constructed model was transferred to the remaining 60 patients, which was assigned as test dataset (TD). The survival distribution between populations with predicted short and long OS was compared using log-rank test.

**RESULTS:** Distributions of the analyzed data were as follows; 53 short OS cases in the TR (53.0%) and 27 cases in the TD (45.0%). As for the result of transfer analysis in TD, 38 cases out of 60 (63.3%) were predicted to be short OS (78.4% recall, 54.3% of precision, and 63.5% of F-measure). The population of predicted short OS significantly showed poorer prognosis (median OS 14.0 vs 19.1 months) (p<0.02, log-rank test). CONCLUSION: Short OS was successfully identified from preoperative MRI with high recall rates for our algorithm. The presented result ensures the potential of machine learning-based texture analysis for prognostic stratification of nGBM.

**NI-14**

**EVALUATION OF PREOPERATIVE APPARENT DIFFUSION COEFFICIENT (ADC) OF PERITUMORAL LESION FOR PREDICTING SITE PRONE TO RECURRENCE IN PATIENTS WITH GliOBLASTOMA**

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**PURPOSE:** In the surgery of glioblastoma (GBM), the maximum safe resection is desired in order to prevent recurrence. The purpose of this study is to make it possible to evaluate the site in which the recurrence after resection and the irradiation range in radiation treatment.

**METHODS:** The 26 cases with GBM treated in our department were investigated. Preoperative MRI, postoperative MRI, and follow-up MRI during the course were analyzed in a retrospective view. In the FLAIR high signal area around the contrast-enhanced tumor body in preoperative MRI, we investigated the relationship between the site and the ADC value, from the standpoint of whether a recurrence occurred or not. RESULTS: For preoperative MRI of 26 patients, the FLAIR high-signal region was set to a total of 54 ROI, and several values, such as the ADC value, were measured. In the preoperative images, ADC were higher in the site where the no recurrence occurred during the postoperative course and lower in the site where the recurrence occurred. CONCLUSION: In the FLAIR high-signal area around the tumor during the preoperative stage, ADC value is useful in evaluating whether it has tendency to develop the recurrence in the future course or not. It was suggested that significant recurrence occurs at part with low-ADC value. It is considered useful for the planning of the extent of resection in the surgery and the irradiation range in radiation treatment.

**NI-15**

**THE USEFULNESS OF PET IMAGING IN MOLECULAR DIAGNOSIS OF GliOMA**

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**OBJECTIVE:** After WHO 2016 Classification of Tumors of the Central Nervous System have published, molecular diagnosis became part of the diagnostic criteria. In this study, we investigated the correlation between PET images and molecular diagnosis of glioma. METHODS: We performed retrospective review of newly diagnosed supratentorial glioma patients who preoperatively underwent all four PET examinations ([18F]-FDG, [18F]-MET, [11C]-FLT and [18F]-FMISO) from April 2009 to March 2019. The standardized uptake value (SUV) from the accumulation of each PET tracers, TNR (tumor to contralateral normal tissue ratio) of [18F]-FDG, [11C]-MET and [18F]-FLT, TBR (tumor to blood values ratio) of [18F]-FMISO were measured. We investigated the correlation between these PET images and molecular diagnosis of glioma. RESULTS: Data from total of 79 patients which were 42 cases of IDH wild type glioblastoma, 2 cases of IDH mutated glioblastoma, 9 cases of IDH wild type astrocytoma, 13 cases of IDH mutated astrocytoma and 13 cases of IDH mutated and 1p/19q co-deleted oligodendroglialoma were included in this study. Both TNR of [18F]-MET(p<0.01) and [11C]-FLT(p<0.01), and also TBR of [18F]-FMISO(p<0.01) in IDH wild type gliomas showed significantly higher than IDH mutated gliomas. In WHO Gr2-3 gliomas, only TNR of [18F]-FLT showed a significant difference between IDH wild type gliomas and IDH mutated gliomas(p<0.01), TNR of [18F]-FMISO(p<0.01) and TBR of [18F]-FMISO(p<0.01) in 1p/19q co-deleted gliomas were significantly lower than gliomas without 1p/19q co-deletion, but there were no significant differences in WHO Gr2-3 gliomas. Among IDH mutated gliomas, TNR of [18F]-FMISO(p<0.01) in 1p/19q co-deleted gliomas showed significantly higher uptake than gliomas without 1p/19q co-deletion(p<0.05). CONCLUSION: Preoperative PET evaluation of each PET tracers may be useful for the molecular diagnosis of glioma.

**NI-17**

**T2-FLAIR MISMATCH SIGN IN DIFFUSE GLIOMA AND DYSMBRYOPLASTIC NEUROEPITHELIAL TUMOR**

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**BACKGROUND:** T2-FLAIR mismatch sign was reported as a specific imaging marker for diffuse astrocytoma with IDH-mutant and 1p/19q non-codeletion. However, most of the previous studies for T2-FLAIR mismatch were confirmed only among low grade glioma. The purpose of this study is to assess a possible differential diagnostic criteria. In this study, we analyzed the 3T MRI data of 79 patients which were 42 cases of IDH mutant and 1p/19q non-codeletion, diffuse midline glioma and dysmyeloblastic neuroepithelial tumor (DNT) to unveil the exception rules of the sign. METHODS: In total, 51 patients were included in this study; 35 supratentorial diffuse glioma (18 diffuse astrocytoma with IDH mutant (IDHmut-Noncodel), 12 oligodendroglia with IDH mutant and 1p/19q codeletion (IDHmut-Codel)), 3 diffuse astrocytoma with IDH wildtype (IDHwt), 18 diffuse midline glioma and 11 DNT. The tumors were evaluated by 2 independent reviewers to assess presence or absence of T2-FLAIR mismatch sign. RESULT: Ten out of 18 cases of IDHmut-Noncodel presented T2-FLAIR mismatch sign. None of the other supratentorial diffuse glioma (IDHmut-Code and IDHwt) presented T2-FLAIR mismatch sign. T2-FLAIR mismatch sign for IDHmut-Noncodel presented 100% positive predictive values among supratentorial diffuse glioma. However, 8 out of 18 cases of diffuse midline glioma and 8 out of 11 cases of DNT also presented the T2-FLAIR mismatch sign. CONCLUSION: The T2-FLAIR mismatch sign was specific marker for IDHmut-Noncodel model among supratentorial diffuse glioma. Physicians need to be aware that diffuse midline glioma and DNT could present the T2-FLAIR mismatch sign.

**NI-18**

**INVASIONS OF WHITE MATTER AS A PROGNOSTIC FACTOR IN LOW GRADE GLIOMAS**

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**INTRODUCTION:** Gliomas of cerebi (GC), which was characterized by widespread infiltration of the brain involving three lobes, was deleted in the 2016 WHO classification. However, it is known that gliomas with
GC growth pattern have a poor prognosis even in low histological grading. In this study, we focused on tumor invasion into white matter fibers. We analyzed the MRI findings focusing on white matter fibers and compared in patients with histologically proven low grade gliomas (LGGs) with GC pattern and localized LGGs. METHOD: The patients can be classified into four groups according to the range of tumor invasion in T2-weighted image as follows: group 1, more than 3 lobes (n=6); group 2, 1 or 2 lobes infiltrate the bi-lateral frontal and/or temporal lobes (n=7); group 3, multicentric (n=2) and group 4 (n=12) localized. In reference to the human brain white matter atlas, the infiltration to the major white matter fibers (uncinate fasciculus, genu, corpus callosum) was examined. RESULTS: Twenty-five patients (median age 39.5 years) were included in the study. Of these, 20 patients were histologically diagnosed with diffuse astrocytomas, and 5 patients with oligodendrogliomas. The infiltrations into sfo, slf, and if of white matter fibers were a poor prognostic factor. The number of infiltrating white matter fibers correlated significantly with the Kaplan-Meier survival curve. CONCLUSION: The 2016 WHO classification defines diagnostic entities by combining molecular and histological information and remove GC as a distinct glioma entity. LGGs with GC pattern should be considered to be detected in different types of histologically and molecularly defined gliomas. As the patient numbers analyzed here were small, and larger series reproducing these results would be desirable. MRI findings particularly focusing on infiltration of LGGs into white matter fibers might be important to estimate the prognosis of patients.

NI-19 USEFULNESS OF AMIDE PROTON TRANSFER IMAGE IN IMAGING DIAGNOSIS OF GLIOMA.
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INTRODUCTION: APT image is one of the imaging methods in MRI, and it is a molecular image that visualizes the concentration of an amide group having an amino acid increasing in a tumor, and is expected to be clinically applied in the imaging diagnosis of glioma. On the other hand, MET-PET is useful for diagnosis of glioma because it is well accumulated in tumor cells. Based on the results of pathological diagnosis, we compared the two and verified that APT image is useful. METHOD: The study included 36 patients who underwent APT image and MET-PET. (Glioma WHO2016 GradeII/III/IV and Pseudoprogression). MET-PET was administered 370MBq/kg, and the accumulation ratio (TNR) of the tumor part to the normal part was measured. APT image measured APT signal with the region of interest at the tumor site. RESULTS: APT signal in all 36 cases was correlated with 2.19±0.94 and TNR with 2.61±1.55 (r=0.67, p<0.001). The discrimination accuracy between GI/III/IV and Pseudoprogression by APT signal was 84% sensitivity and 100% specificity at threshold 2.0. APT signal 2.30±0.43, TNR 4.02±2.12, GI/III/IV APT signal 2.67±0.69, TNR 2.81±0.72, GIV APT signal 2.78±0.61, TNR 3.37±1.28 in grade diagnosis At high grade, APT signal and TNR were high. The APT signal of the oligodendroglioma (GI/III) was 2.44±0.90, the TNR was 3.78±1.51. The APT signal of the astrocytoma line (GI/III) was 2.69±0.51, and the TNR was 2.43±0.98. The oligodendroglioma line was lower in APT signal than the astrocytoma line, and the TNR was higher. DISCUSSION: APT image is non-invasive, can easily provide important information, and have the same diagnostic potential as MET-PET. Although TNR of oligodendroglioma (GI/III) tends to be high, the APT signal which is not affected by infiltration of LGGs into white matter fibers might be important to estimate the prognosis of patients.

NI-20 IS GLIOMATOSIS CEREBRI DIAGNOSED AS GRADEII IN NEUROIMAGING A POTENTIALLY GRADEII GLIOMA?
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The 2007 World Health Organization (WHO) classification defined gliomatosis cerebri (GC) as a rare entity and an extensively infiltrating diffuse glioma involving three or more cerebral lobes. Although the revised 2016 WHO classification removed GC as a separate glioma entity due to the common histopathological findings shared with other gliomas, GC exhibits a distinct growth pattern and worse prognosis compared with other grade II/III matched gliomas. We retrospectively reviewed five patients with GC and five patients with insulo-opercular diffuse astrocytoma (IODA) who underwent both proton magnetic resonance spectroscopy (MRS) and [11C]-methionine positron emission tomography (MET-PET). The patients were diagnosed with GC or IODA by T2-weighted magnetic resonance imaging /fluid-attenuated inversion recovery from April 2014 to August 2019 at our institution. The locations of lesions where single-voxel MRS to measure the N-acetylaspartate (NAA)/cholesterol (Cho) ratio and MET-PET to measure the tumor/normal (T/N) ratio were performed were the same in every patient.

The mean age of all patients was 46.3±13.7 years. The mean ages of the GC (three males and two females) and IODA (two males and three females) groups were 54.6±14.0 and 38.6±6.7 years, respectively. The mean NAA/Cho ratios in the GC and IODA groups were 1.010±0.441 and 0.594±0.449, respectively. The mean T/N ratios in the GC and IODA groups were 1.201±0.030 and 1.169±0.009, respectively.

The higher NAA/Cho ratio in the GC group may reflect the abundance of normal neural tissue in GC compared with IODA. Nonetheless, the T/N ratios of the two groups were comparable. The discrepancy suggests that GC cells have higher tumor metabolic activity than IODA cells. Therefore, when GC is simply classified as grade II glioma based on neuroimaging diagnosis, the possibility of underestimating its malignant potential at the single-cell level should be considered.

NI-22 IMPROVED DELINEATION OF THE SUPERFICIAL CEREBRAL VENOUS SYSTEM IN BRAIN CT ANGIOGRAPHY BY ULTRA-HIGH-RESOLUTION CT FOR ASSISTING BRAIN TUMOR SURGERY
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BACKGROUND: In brain CT angiography (CTA) for assisting brain tumor surgery, delineation of the superficial cerebral venous system is critical for selecting the optimal surgical approach. This delineation is, however, limited using conventional CT scanners, including an area-detector CT (ADCT) scanner, due to their insufficient spatial resolution. Since March 2017, a state-of-the-art ultra-high-resolution CT (UHRCT) scanner has been clinically available to improve in- and through-plane spatial resolution compared with conventional CT scanners, mainly due to smaller slice thickness from 0.5 mm to 0.25 mm, larger channel number from 896 to 1792, and smaller x-ray focus from 0.9 x 0.8 mm to 0.4 x 0.5 mm. Purpose We assessed usefulness of UHRCT to improve delineation of the superficial cerebral venous system in brain CTA for assisting brain tumor surgery compared with conventional ADCT. METHODS: We retrospectively enrolled patients with intra- and/or extra-axial brain tumors who underwent preoperative brain CT angiography (CTA) for assisting brain tumor surgery by UHRCT or ADCT using our routine technique and generated the CTA to delineate the superficial cerebral venous system using the same technique. Two reviewers by consensus subjectively counted the number of the superficial sylvian veins and the cortical veins draining into these veins and the maximal bifurcation order of the cortical veins draining into the superior sagittal sinus. We compared these numbers between the UHRCT and ADCT groups using the intraoperative findings as the reference. RESULTS: The numbers and the maximal bifurcation order in the UHRCT group were significantly greater and more accurate than those in the ADCT group. CONCLUSIONS: Use of UHRCT can be clinically useful for better delineating the superficial cerebral venous system in brain CTA and assisting brain tumor surgery.

NI-23 ULTRA-HIGH-RESOLUTION CT ANGIOGRAPHY FOR BRAIN TUMOR SURGERY
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BACKGROUND: Preoperative accurate evaluation of arteries and veins can help avoid ischemic complication of brain tumor surgery. The latest ultra-high-resolution CT (UHRC) angiography (Aquilion PrecisionTM; Canon Medical Systems) has recently become available for clinical testing of the main arteries and critical perforating arteries by brain CT, compared to conventional CT. METHODS: UHRC provides slice collimation of 0.25 mm x 160 and matrix size of 1024 x 1024 or 2048 x 2048. Major features of this CT scanner include an improved detector system (the minimum slice thickness, 0.25 mm; the maximal channel number, 1792) and a smaller x-ray focus from 0.9 x 0.8 mm to 0.4 x 0.5 mm. Purpose We assessed usefulness of UHRC to improve delineation of the superficial cerebral venous system compared with preoperative CTA using our routine technique and generated the CT to delineate the superficial cerebral venous system using the same technique. Two reviewers by consensus subjectively counted the number of the superficial sylvian veins and the cortical veins draining into these veins and the maximal bifurcation order of the cortical veins draining into the superior sagittal sinus. We compared these numbers between the UHRC and ADCT groups using the intraoperative findings as the reference. RESULTS: The numbers and the maximal bifurcation order in the UHRC group were significantly greater and more accurate than those in the ADCT group. CONCLUSIONS: Use of UHRC can be clinically useful for better delineating the superficial cerebral venous system in brain CTA and assisting brain tumor surgery.