# 11C methionine positron emission tomography for glioma

- Visualization of P2X7 Receptors in Living Human Gliomas: An 18F-GSK1482160 PET Imaging and Neuropathology Study
- Three-dimensional amide proton transfer (APT) imaging appliable to navigation surgery can present comparable metabolic activity of glioblastoma to <sup>11</sup>C-Methionine PET
- Higher Uptake of Preoperative 11C-Methionine Positron Emission Tomography Related to Preoperative Seizure in Patients With Oligodendroglioma
- Deep mutual learning on hybrid amino acid PET predicts H3K27M mutations in midline gliomas
- PET/CT with 11C-methionine as a predictor of disease-free survival in patients with IDH1 wild type diffuse glioma
- Value of 11C-Methionine PET Imaging in High-Grade Gliomas: A Narrative Review
- <sup>11</sup>C-methionine in the diagnostics and management of glioblastoma patients with rapid early progression: nonrandomized, open label, prospective clinical trial (GlioMET)
- [11C]-methionine positron emission tomography in the evaluation of pediatric low-grade gliomas

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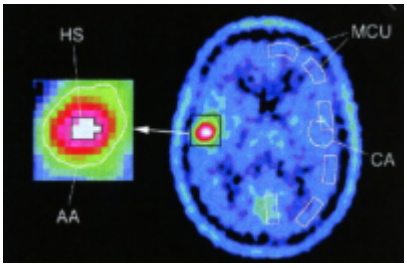


11C methionine positron emission tomography is commonly used to evaluate gliomas at diagnosis. A study by Ninatti et al. aimed to assess the prognostic value of MET PET in newly diagnosed, treatment IDH-wt gliomas with histological features of LGGs.

Patients with a histological diagnosis of IDH-wt LGG who underwent preoperative (< 100 days) MET PET/CT and surgery were retrospectively included. Qualitative and semi-quantitative analyses of MET PET images were performed. Progression-free survival (PFS) and overall survival (OS) were analyzed by Kaplan-Meier curves. Cox proportional-hazards regression was used to test the association of imaging and clinical data to PFS and OS.

They included 48 patients (M: F = 25:23; median age 55). 39 lesions were positive and 9 negative at MET PET. Positive MET PET was significantly associated with shorter median PFS (15.7 months vs. not reached, $p = 0.0146$) and OS time (32.6 months vs. not reached, $p = 0.0253$). Incomplete surgical resection and higher TBRmean values were independent predictors of shorter PFS on multivariate analysis ($p < 0.001$ for both). Higher tumor grade and incomplete surgical resection were independent predictors of OS at multivariate analysis ($p = 0.027$ and $p = 0.01$, respectively).

MET PET is useful for the prognostic stratification of patients with IDH-wt glial neoplasms with histological LGGs features. Considering their huge biological heterogeneity, the combination of MET PET and molecular analyses may help to improve the prognostic accuracy in these diffuse glioma

subsets and influence therapeutic choices accordingly [1].

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Inoue et al. investigated the relationship of tumor volume between MRI and 11C methionine positron emission tomography and also the relationship between Met uptake index and tumor activity. In ten patients, tumor-to-contralateral normal brain tissue ratio (TNR) was calculated to evaluate the metabolic activity of Met uptake areas which were divided into five subareas by the degrees of TNR. In each Glioblastoma, tumor tissue was obtained from subareas showing the positive Met uptake. Immunohistochemistry was performed to examine the tumor proliferative activity and the existence of glioma stem cells (GSCs). In all patients, the volume of Met uptake area at TNR ≦ 1.4 was larger than that of the Gd-enhanced area. The Met uptake area at TNR 1.4 beyond the Gd-enhanced tumor was much wider in high invasiveness-type Glioblastomas than in those of low invasiveness type, and survival was much shorter in the former than the latter types. Immunohistochemistry revealed the existence of GSCs in the area showing Met uptake at TNR 1.4 and no Gd enhancement. Areas at TNR > 1.4 included active tumor cells with a relatively high Ki-67 labeling index. In addition, it was demonstrated that GSCs could exist beyond the border of the Gd-enhanced tumor. Therefore, to obtain maximum Glioblastoma extent of resection, including infiltrating GSCs, an aggressive surgical excision that includes the Met-positive area at TNR 1.4 should be considered [2].

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11C methionine positron emission tomography/MRI based texture analysis and conventional features may be a promising noninvasive predictor for differentiating the varied gliomas [3].

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MET PET appears to be useful in evaluating grade, type, and proliferative activity of astrocytic tumor (AT). CHO PET may be useful in evaluating the potential malignancy of oligodendroglial tumors (OTs). In terms of visual evaluation of tumor localization, MET PET is superior to FDG and CHO PET in all of the gliomas, due to its straightforward detection of “hot lesions” [4].

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MET-PET is a helpful tool for pretreatment evaluation of non-contrast media enhancing, suggestive low-grade intracerebral lesions. MET-PET adds valuable information for the decision-making for surgery or stereotactic biopsy [5].

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The aim of a study of Beppu et al., was to clarify whether arterial spin labeling (ASL) perfusion imaging can assess biological effects from bevacizumab (BEV) therapy as reliably as PET with 11C methionine positron emission tomography.

Twenty-four patients with Glioblastoma recurrence were examined using both ASL and C-met-PET before and 4 and 8 weeks after starting BEV treatment. Tumor-to-normal brain (T/N) ratios, fluctuations in T/N ratio, and tumor volumes were compared between ASL and C-met-PET. Accuracy of predicting patient with long progression free survival (PFS) was assessed for T/N ratios and fluctuations for ASL and C-met-PET in each phase and in each period using receiver operating characteristic curves. Between 2 groups of patients assigned by cutoff values from receiver operating

characteristic curves, PFS was compared in each phase or in each period.

T/N ratios, fluctuations in ratio, and tumor volumes correlated significantly between ASL and C-met-PET at all time points and all periods. Arterial spin labeling was eligible as a predictor for long PFS only in assessment of fluctuations in T/N ratio. However, the most accurate predictors for long PFS were T/N ratio from C-met-PET at 8 weeks and the fluctuation from baseline to 4 weeks in T/N ratio from C-met-PET.

Blood flows on ASL correlated with accumulations of C-met on PET in Glioblastoma recurrence under BEV treatment. Although C-met-PET offered superior accuracy for predicting patients with long PFS from time points, ASL offered reliable prediction of long PFS, provided that fluctuations in T/N ratio between consecutive scans are assessed [6].

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The metabolically active tumour volume observed in (11)C-methionine PET differs from the volume of MRI by showing areas of infiltrative tumour and distinguishing from non-tumour lesions. Differences in (11)C-methionine PET/MRI integration patterns can be assigned to tumour grades according to the WHO classification. This finding may improve tumour delineation and therapy planning for gliomas [7].

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11C methionine positron emission tomography parameters are significantly correlated with histological grade and IDH1 mutation status in patients with glioma. Grade, pathological classification, molecular biomarkers, SUVmax and SUVratio were prognostic factors for PFS in a cohort of patients. The trial was registered with ClinicalTrials.gov (registration: NCT02518061) [8].

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# References

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