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C-Methionine PET: Indispensable Tool for the Management of Brain Tumors

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C-methyl-methionine (MET) is the most celebrated, widely and regularly employed amino acid used as a tumor-imaging agent in positron emission tomography (PET). While MET is easily synthesized (1), the short halflife of the carbon-11 component presents a disadvantage. The mechanism of MET uptake in gliomas depends primarily on the L-like transport system. This latter system is related to the proliferation rate of human glioma cells in vitro (2). Unlike 18F-fludeoxyglucose (FDG), MET diffuses less into both inflammatory and normal brain tissue. Consequently MET-based imaging detects and delineates cerebral tumors more efficiently than FDG (3) Accordingly, MET accumulates readily in gliomas, even when MRI or CT contrast enhancement is absent (4, 5), and FDG uptake is low (3, 6, 7). This property ensures that a PET-MET semi-quantitative analysis technique is able to accurately monitor the effects of chemotherapy in gliomas, particularly for low-grade oligodendrogliomas (16). Additionally, using PET-MET is possible to differentiate between recurrent brain tumors and radiation necrosis following radio-surgery in malignant glioma (8).

We have previously addressed the importance of PET-MET for use in the stereo-tactic guidance of brain biopsies in previous studies (9-12), and also in the delineation of the target area prior to radio-surgery or neuronavigation. Indeed, we have found that uptake of MET was significantly higher in tumors showing anaplastic changes (13). (Figure 1)

Radio-surgical techniques such as the ‘Leksell Gammaknife’ have acquired a considerable reputation in the management of brain tumors as they both destruct the brain target lesion by focusing large numbers of radiation beams on the abnormal brain area, whilst preserving the normal surrounding structures, without jeopardizing patient safety. In our institution, we employ a fucidial system in radio-surgery, namely a stereo-tactic framefilled with isotope and secured in a customized head holder, permitting fast and analogous positioning during CT, MRI and PET procedures. This method provides submillimeter spatial accuracy for the co-registration of PET-MET with MRI and/or CT imaging (14), and so optimizes radio-surgical targeting. Adding in the metabolic information delivered by MET imaging, to the result of the morphological CT/MRI analysis, turns out to be crucial to effecting an improvement in radio-surgical treatment of complex clinical situations (i.e. pituitary tumors and infiltrative primary tumors) (15).

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