Positron emission tomography and single-photon emission tomography in neurosciences

To the Editor: In their interesting editorial, Fotopoulos and Alexiou [1] focus on imaging of brain tumors (gliomas). There is a clear indication for positron emission tomography (PET) in gliomas, and, if possible, there should be a combined glucose metabolism/amino acid transport approach, e.g., by first scanning with ^{11}C-methionine and subsequently, without moving the patient, with fluorine-18-fluorodeoxyglucose (^{18}F-FDG) [2]. For tumor recurrence, a PET/ computed tomography (CT) may be favourable to detect new tumor cells near the resection margins.

Of course, in gliomas there may be a role for SPET and some tracers (such as mentioned by the authors [1], for instance ^{99m}Tc-tetrofosmine, ^{99m}Tc-sestamibi, ^{201}Tl or, as may be added: ^{123}I-alpha-methyltyrosine [3]), especially if a PET device and a nearby cyclotron are not available. Given the superior spatial and molecular resolution, PET, however, remains the gold standard imaging tool for this tumor entity.

This is quite the contrary in other brain imaging indications in neurosciences [e.g., 4]. Besides, where the anatomy is not altered–it is changed e.g. in brain injury or after brain surgery–, even a hybrid system (single photon emission tomography (SPET)/CT or PET/CT) may not add any substantial diagnostic plus, even more if the SPET or PET scan is analyzed with statistical parametric mapping, allowing for interindividual comparisons in the Talairach and Tournoux anatomical atlas coordinate system [5, 6].

In some neuroscience indications there can be indeed some advantages of SPET over PET imaging, e.g., in sleep or epilepsy research studies: In these studies, the SPET perfusion tracer ^{99m}Tc-ethylcysteinate dimer (ECD) can be injected during the ictus or the sleep phase of interest, the status of the brain during the injection is then "frozen", and due to the half-life of ^{99m}Tc and the stability of ECD the scan can be performed some hours later, after the patient is awake or the seizure is over [7].

In conclusion, there are many examples for SPET and PET in neurology, neurobiological systems and psychiatry showing the importance especially of SPET studies that add value to the knowledge in medical research and routine.

The authors declare that they have no conflicts of interest.

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Authors Reply:

SPET in brain tumor imaging

To the Editor: We read with great interest the letter by Dr Otte on the role of positron emission tomography (PET) in neurooncology [1]. Indeed, it is of great importance the higher spatial resolution of PET compared to single-photon emission tomography (SPET). Nevertheless, in the latest generation PET/CT scanners the spatial resolution is approximately 3.5mm [2]. The spatial resolution of SPET is about 8mm. However, the majority of brain tumors have a considerable size (usually >1cm) before giving raise to symptoms. Another important issue is that SPET is a relatively low-cost imaging modality compared with PET.

Regarding tracers, the fluorine-18-fluorodeoxyglucose (^{18}F-FDG), the most extensively studied PET tracer, has the disadvantage of a high background because of the high basal glucose metabolic rate of normal brain tissue. Thus, a brain lesion might not be readily identifiable. The same stands, to a lesser degree, for ^{11}C-methionine and ^{18}F-3′-deoxy-3′-fluorothymidine (^{18}F-FLT). SPET tracers such as technetium-99m-hexakis-2-methoxy isobutyl isonitrile (^{99m}Tc-sestamibi) and ^{99m}Tc-tetrofosmin (^{99m}Tc-TF) have a negligible background uptake that permits not only the brain lesions that accumulate the tracer avidly, but even those that do so faintly, to be readily identifiable. Additionally, one major advantage of ^{99m}Tc-TF compared to ^{99m}Tc-sestamibi, is that ^{99m}Tc-TF accumulation rates are not influenced by the multidrug resistance phenotype of gliomas. ^{99m}Tc-sestamibi accumulation may be minimal in high-grade gliomas that express multidrug resistance proteins [3, 4]. As compared to radiolabelled amino acids, ^{99m}Tc-TF has the certain advantage of not crossing the intact blood brain barrier, thus not exhibiting uptake in nor-

mal brain parenchyma. Apart from that, we have recently compared dynamic susceptibility contrast perfusion MRI with ^{99m}Tc-TF brain SPET for the differentiation of glioma recurrence from treatment induced necrosis. The results of the study showed that both imaging modalities had the same accuracy. Furthermore, there was a strong correlation between relative cerebral blood volume (rCBV) values and lesion to normal ^{99m}Tc-TF uptake ratios [unpublished data].

In conclusion, we believe that SPET, especially with ^{99m}Tc-TF, may be a viable alternative for brain tumor imaging. Nowadays, the lower cost of SPET is another important issue, alongside with worldwide availability Furthermore; we believe that well-designed prospective studies comparing the available imaging modalities and nuclear medicine tracers are urgently needed.

The authors declare that they have no conflicts of interest.

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Hell J Nucl Med 2012; 15(3): 256-257 Published on line: 2 December 2012