Positron emission tomography for glioma

Positron emission tomography (PET) scan. Low grade fibrillary astrocytomas appear as hypometabolic "cold" spots with fluorodeoxyglucose PET scans. Hypermetabolic "hot" spots suggest highgrade (III or IV) astrocytomas and help distinguish high-grade glioma s that do not enhance on MRI from lower grade (II) astrocytomas.

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see also 18F positron emission tomography for high-grade glioma.

PET imaging using MET, CHO, and FDG was suggested to be informative for preoperatively differentiating gliomas according to the 2016 WHO classification, particularly for differentiating IDH-wt and IDH-mut tumors [1].

PET provides additional insight beyond MRI into the biology and treatment response of gliomas which may be used for noninvasive grading, differential diagnosis, delineation of tumor extent, surgical and radiotherapy treatment planning, posttreatment surveillance, and prognostication.

Analogous to the RANO effort regarding MRI use in gliomas, an initiative was undertaken by a group of clinicians and nuclear medicine physicians to similarly define standards of molecular imaging for gliomas using PET with respect to interpretation and validation as well as to define its role in clinical practice. In this paper, evidence-based recommendations are proposed for the use of PET imaging in the clinical management of glioma patients. Accordingly, the review discusses tracers which image glucose metabolism—18F-2-fluoro-2-deoxy-d-glucose (18F-FDG)—and amino acid transport ([11C-methyl]-methionine (11C-MET), O-(2-[18F]-fluoroethyl)-l-tyrosine (18F-FET) and 3,4-dihydroxy-6-[18F]-fluoro-l-phenylalanine 18F-FDOPA PET, since these compounds have already entered clinical practice.

The current guidelines aim to serve medical professionals of all disciplines involved in the diagnosis and care of patients with gliomas. A separate procedural guideline focusing on the standardization of technical aspects of PET imaging for glioma will be the subject of another paper prepared by the EANM (European Association of Nuclear Medicine)/EANO (European Association of Neuro-Oncology)/RANO groups [2].

Molecular imaging such as positron emission tomography (PET) is one of the most promising approaches to gliomas.

PET provides live information of metabolism through the behavior of single molecules. The advantage of PET is that its noninvasive analysis does not require tissue sample, therefore examination can be performed repeatedly. This is very useful for capturing changes in the biological nature of tumor without biopsy.

A review examines established clinical benefit in glioma patients of PET using glucose [3].

In the present clinical practice for glioma, 18F positron emission tomography is the most common tracer for predicting prognosis and differentiating other malignant brain tumors. Amino acid tracers such as (11)C-methionine (MET) are the most useful for detecting distribution of glioma, including low-

grade. Tracers to image hypoxia are under investigation for potential clinical use, and recently, (18)F-fluoromisonidazole (FMISO) has been suggested as an effective tracer to distinguish glioblastoma multiforme from others [4].

1)

Takei H, Shinoda J, Ikuta S, Maruyama T, Muragaki Y, Kawasaki T, Ikegame Y, Okada M, Ito T, Asano Y, Yokoyama K, Nakayama N, Yano H, Iwama T. Usefulness of positron emission tomography for differentiating gliomas according to the 2016 World Health Organization classification of tumors of the central nervous system. J Neurosurg. 2019 Aug 16:1-10. doi: 10.3171/2019.5.JNS19780. [Epub ahead of print] PubMed PMID: 31419796.

2)

Albert NL, Weller M, Suchorska B, Galldiks N, Soffietti R, Kim MM, la Fougère C, Pope W, Law I, Arbizu J, Chamberlain MC, Vogelbaum M, Ellingson BM, Tonn JC. Response Assessment in Neuro-Oncology working group and European Association for Neuro-Oncology recommendations for the clinical use of PET imaging in gliomas. Neuro Oncol. 2016 Sep;18(9):1199-208. doi: 10.1093/neuonc/now058. Epub 2016 Apr 21. Review. PubMed PMID: 27106405; PubMed Central PMCID: PMC4999003.

3)

18)F-FDG) and amino acid tracers ((11)C-MET, (18)F-FET, and (18)F-FDOPA). An increasing number of studies have been published on PET imaging in the setting of diagnosis, biopsy, and resection as well radiotherapy planning, treatment monitoring, and response assessment. Recommendations are based on evidence generated from studies which validated PET findings by histology or clinical course ((Albert NL, Weller M, Suchorska B, Galldiks N, Soffietti R, Kim MM, la Fougère C, Pope W, Law I, Arbizu J, Chamberlain MC, Vogelbaum M, Ellingson BM, Tonn JC. Response Assessment in Neuro-Oncology working group and European Association for Neuro-Oncology recommendations for the clinical use of PET imaging in gliomas. Neuro Oncol. 2016 Sep;18(9):1199-208. doi: 10.1093/neuonc/now058. Epub 2016 Apr 21. Review. PubMed PMID: 27106405; PubMed Central PMCID: PMC4999003.

4)

Kobayashi H, Hirata K, Yamaguchi S, Terasaka S, Shiga T, Houkin K. Usefulness of FMISO-PET for glioma analysis. Neurol Med Chir (Tokyo). 2013;53(11):773-8.Epub 2013 Oct 29. PubMed PMID: 24172591.