18F FET PET

Indications

18F-FET PET may provide additional diagnostic information compared to standard MRI in neuro-oncology [1].

The addition of 18F FET PET to MRI helped discriminate tumor from non-tumor lesions in the largest consecutive cohort of pediatric CNS tumor patients [2]

18F-FET PET may be useful in the differential diagnosis between brain tumors and non-neoplastic lesions and between low-grade and high-grade gliomas. Integration of 18F-FET PET into surgical planning allows better delineation of the extent of resection beyond margins visible with standard MRI. For biopsy planning, 18F-FET PET is particularly useful in identifying malignant foci within non-contrast-enhancing gliomas. 18F-FET PET may improve the radiation therapy planning in patients with gliomas. This metabolic imaging method may be useful to evaluate treatment response in patients with gliomas and it improves the differential diagnosis between brain tumours recurrence and post-treatment changes. 18F-FET PET may provide useful prognostic information in high-grade gliomas.

For quantification of standard PET-derived parameters such as the tumor-to-background ratio, the background activity is assessed using a region of interest (ROI) or volume of interest (VOI) in unaffected brain tissue. However, there is no standardized approach regarding the assessment of the background reference [3].

(18)F-Fluoroethyl-l-thyrosine (FET) is a positron emission tomography (PET) radiopharmaceutical applicable for widespread use because of its long half-life radionuclide.

Fluoroethyl Tyrosine Positron Emission Tomography for patients with gliomas undergoing multimodal treatment or various forms of irradiation is a powerful tool to improve the differential diagnosis [4].

FET PET reliably distinguishes between post-therapeutic benign lesions and tumour recurrence after initial treatment of low- and high-grade gliomas [5].

Maps of (18)FET uptake kinetics strongly correlated with histopathology in suspected grade II gliomas. Anaplastic foci can be accurately identified, and this finding has implications for prognostic evaluation and treatment planning [6].

Dynamic 18F-FET PET in suspected WHO grade II gliomas defines distinct biological subgroups with different clinical courses [7].

In Low-grade gliomas 5-aminolevulinic acid fluorescence is the exception and FET PET is more sensitive. High grade areas in diffuse gliomas with anaplastic foci usually fluoresce, if they are FET PET positive. As a result, FET PET appears valuable for pre-operative identification of anaplastic foci and hot spots are strongly predictive for ALA-derived fluorescence, which highlight anaplastic foci during resection [8].

Age, tumor volume, and Fluoroethyl Tyrosine Positron Emission Tomography uptake are factors predicting 5-ALA-induced fluorescence in gliomas without typical glioblastoma imaging features. Fluorescence was associated with an increased Ki67/MIB-1 index and high-grade pathology. Whether fluorescence in grade II gliomas identifies a subtype with worse prognosis remains to be determined [9].

Case series

18F FET PET case series.

1)

Muoio B, Giovanella L, Treglia G. Recent Developments of 18F-FET PET in Neuro-oncology. Curr Med Chem. 2017 Nov 23. doi: 10.2174/0929867325666171123202644. [Epub ahead of print] PubMed PMID: 29173147.

2)

Marner L, Lundemann M, Sehested A, Nysom K, Borgwardt L, Mathiasen R, Wehner PS, Henriksen OM, Thomsen C, Skjøth-Rasmussen J, Broholm H, Østrup O, Forman JL, Højgaard L, Law I. Diagnostic Accuracy and Clinical Impact of [18F]FET PET in Childhood CNS tumors. Neuro Oncol. 2021 Apr 17:noab096. doi: 10.1093/neuonc/noab096. Epub ahead of print. PMID: 33864083.

3)

Unterrainer M, Vettermann F, Brendel M, Holzgreve A, Lifschitz M, Zähringer M, Suchorska B, Wenter V, Illigens BM, Bartenstein P, Albert NL. Towards standardization of (18)F-FET PET imaging: do we need a consistent method of background activity assessment? EJNMMI Res. 2017 Dec;7(1):48. doi: 10.1186/s13550-017-0295-y. Epub 2017 May 30. PubMed PMID: 28560582.

4)

Rachinger W, Goetz C, Pöpperl G, Gildehaus FJ, Kreth FW, Holtmannspötter M, Herms J, Koch W, Tatsch K, Tonn JC. Positron emission tomography with O-(2-[18F]fluoroethyl)-l-tyrosine versus magnetic resonance imaging in the diagnosis of recurrent gliomas. Neurosurgery. 2005 Sep;57(3):505-11; discussion 505-11. PubMed PMID: 16145529.

5)

Pöpperl G, Götz C, Rachinger W, Gildehaus FJ, Tonn JC, Tatsch K. Value of O-(2-[18F]fluoroethyl)- L-tyrosine PET for the diagnosis of recurrent glioma. Eur J Nucl Med Mol Imaging. 2004 Nov;31(11):1464-70. Epub 2004 Jul 10. PubMed PMID: 15248032.

6)

Kunz M, Thon N, Eigenbrod S, Hartmann C, Egensperger R, Herms J, Geisler J, la Fougere C, Lutz J, Linn J, Kreth S, von Deimling A, Tonn JC, Kretzschmar HA, Pöpperl G, Kreth FW. Hot spots in dynamic (18)FET-PET delineate malignant tumor parts within suspected WHO grade II gliomas. Neuro Oncol. 2011 Mar;13(3):307-16. doi: 10.1093/neuonc/noq196. Epub 2011 Feb 3. PubMed PMID: 21292686; PubMed Central PMCID: PMC3064604.

7)

Thon N, Kunz M, Lemke L, Jansen NL, Eigenbrod S, Kreth S, Lutz J, Egensperger R, Giese A, Herms J, Weller M, Kretzschmar H, Tonn JC, la Fougère C, Kreth FW. Dynamic 18F-FET PET in suspected WHO grade II gliomas defines distinct biological subgroups with different clinical courses. Int J Cancer. 2015 May 1;136(9):2132-45. doi: 10.1002/ijc.29259. Epub 2014 Nov 3. PubMed PMID: 25311315.

8)

Ewelt C, Floeth FW, Felsberg J, Steiger HJ, Sabel M, Langen KJ, Stoffels G, Stummer W. Finding the anaplastic focus in diffuse gliomas: the value of Gd-DTPA enhanced MRI, FET-PET, and intraoperative, ALA-derived tissue fluorescence. Clin Neurol Neurosurg. 2011 Sep;113(7):541-7. doi: 10.1016/j.clineuro.2011.03.008. Epub 2011 Apr 20. PubMed PMID: 21507562.

9)

Jaber M, Wölfer J, Ewelt C, Holling M, Hasselblatt M, Niederstadt T, Zoubi T, Weckesser M, Stummer W.

The Value of 5-Aminolevulinic Acid in Low-grade Gliomas and High-grade Gliomas Lacking Glioblastoma Imaging Features: An Analysis Based on Fluorescence, Magnetic Resonance Imaging, 18F-Fluoroethyl Tyrosine Positron Emission Tomography, and Tumor Molecular Factors. Neurosurgery. 2016 Mar;78(3):401-11. doi: 10.1227/NEU.0000000000001020. PubMed PMID: 26366972; PubMed Central PMCID: PMC4747980.