68Ga-DOTA-D-Phe1-Tyr3-octreotide

PET with somatostatin receptor ligand [68Ga-DOTA-D-Phe1-Tyr3-octreotide ([68Ga]Ga-DOTA-TOC) is an established method in radiotherapy planning because of the improved detection and delineation of meningioma tissue.

Imaging of somatostatin receptors (SSTRs) using [111In]diethylenetriaminepentaacetic-acid-octreotide (DTPAOC) has proven to be helpful in the differentiation of meningiomas, neurinomas or neurofibromas, and metastases as well as in the follow-up of meningiomas [1].

A drawback of the SPECT method is its limited sensitivity in detecting small meningiomas. Because of PET's increased spatial resolution and its ability to absolutely quantify biodistribution, a PET tracer for SSTR imaging would be desirable.

[68Ga]DOTATOC seems to be a very promising new PET tracer for imaging SSTRs even in small meningiomas, offering excellent imaging properties and a very high tumor-to-background ratio.

(68)Ga-DOTATOC-PET enables delineation of SR-positive meningiomas and delivers additional information to both CT and MRI regarding the planning of stereotactic radiotherapy. The acquisition on a PET/CT scanner helps to estimate the relation of PET findings to anatomical structures and is especially useful for detection of osseous infiltration. (68)Ga-DOTATOC-PET also allows detection of additional lesions in patients with multiple meningiomas [2].

DOTATOC-PET/CT information may strongly complement patho-anatomical data from MRI and CT in cases with complex meningioma and is thus helpful for improved target volume delineation especially for skull base manifestations and recurrent disease after surgery [3].

Due to somatostatin receptor expression in meningiomas, PET with somatostatin analogues appears to be useful in radiotherapy treatment planning [4].

The high uptake of (68)Ga-DOTA-TOC in meningiomas can be explained by the high values for vB and by the remarkably low values for k2 and k4, leading to significantly greater k1/k2 and k3/k4 ratios and RB in meningiomas than in reference tissue. Thus, pharmacokinetic modeling offers a more detailed analysis of biologic properties of meningiomas. In further studies, these data might serve as a basis for monitoring the somatostatin receptors of meningiomas after radiotherapy [5].

Data demonstrate that [68Ga]-DOTATOC-PET improves target definition for FSRT in patients with intracranial meningiomas. Radiation targeting with fused DOTATOC-PET, CT, and MRI resulted in significant alterations in target definition in 73% [6].

DOTATOC-PET/CT shows a high meningioma to background ratio which can be used to improve target volume definition prior to intensity modulated radiotherapy (IMRT). [7] [8].

Bashir et al. investigated the diagnostic accuracy of supplementary [68Ga]Ga-DOTA-TOC PET in

patients with a 3-month postoperative MRI reporting gross-total resection (GTR).

Thirty-seven patients with a histologically proven meningioma and GTR on postoperative MRI were prospectively referred to [68Ga]Ga-DOTA-TOC PET. Detection and volume measurements of [68Ga]Ga-DOTA-TOC-avid lesions in relation to the primary tumor site were recorded. Residual tumor in suspicious lesions suggested by [68Ga]Ga-DOTA-TOC PET was verified by (i) tumor recurrence/progression on subsequent MRI scans according to the Response Assessment of Neuro-Oncology criteria, (ii) subsequent histology, and (iii) follow-up [68Ga]Ga-DOTA-TOC PET scan.

Twenty-three PET scans demonstrated [68Ga]Ga-DOTA-TOC-avid lesions suspicious of residual meningioma, where 18 could be verified by (i) tumor progression on subsequent MRI scans (n = 6), (ii) histologic confirmation (n = 3), and (iii) follow-up [68Ga]Ga-DOTA-TOC PET scans confirming the initial PET findings (n = 9) after an overall median follow-up time of 17 months (range, 9-35 months). In contrast, disease recurrence was seen in only 2 of 14 patients without [68Ga]Ga-DOTA-TOC-avid lesions ($P < 0.0001$). The sensitivity, specificity, and diagnostic accuracy of [68Ga]Ga-DOTA-TOC PET in detecting meningioma residue was 90% [95% confidence interval (CI), 67-99], 92% (95% CI, 62-100), and 90% (95% CI, 74-98; $P < 0.0001$), respectively.

The majority of patients with GTR on 3-month postoperative MRI may have small unrecognized meningioma residues that can be detected using [68Ga]Ga-DOTA-TOC PET [9].

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