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Hybrid PET/MRI of intracranial masses: initial experiences and comparison to PET/CT.

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Abstract

Simultaneous PET and MRI using new hybrid PET/MRI systems promises optimal spatial and temporal coregistration of structural, functional, and molecular image data. In a pilot study of 10 patients with intracranial masses, the feasibility of tumor assessment using a PET/MRI system comprising lutetium oxyorthosilicate scintillators coupled to avalanche photodiodes was evaluated, and quantification accuracy was compared with conventional PET/CT datasets.

METHODS: All measurements were performed with a hybrid PET/MRI scanner consisting of a conventional 3-T MRI scanner in combination with an inserted MRI-compatible PET system. Attenuation correction of PET/MR images was computed from MRI datasets. Diagnoses at the time of referral were low-grade astrocytoma (n = 2), suspicion of low-grade astrocytoma (n = 1), anaplastic astrocytoma (World Health Organization grade III; n = 1), glioblastoma (n = 2), atypical neurocytoma (n = 1), and meningioma (n = 3). In the glial tumors, (11)C-methionine was used for PET; in the meningiomas, (68)Ga-DOTATOC was administered. Tumor-to-gray matter and tumor-to-white matter ratios were calculated for gliomas, and tracer uptake of meningiomas was referenced to nasal mucosa. PET/MRI was performed directly after clinically indicated PET/CT examination.

RESULTS: In all patients, the PET datasets showed similar diagnostic image quality on the hybrid PET/MRI and the PET/CT studies; however, slight streak artifacts were visible in coronal and sagittal sections when using the higher intrinsic resolution of the PET/MRI insert. Prefiltering of images with a 4-mm gaussian filter at a resolution comparable to that of the PET/CT system virtually eliminated these artifacts. Although acquisition of the PET/MR images started at 30-60 min after PET/CT (20.4-min half-life of (11)C) acquisition, the signal-to-noise ratio was good enough, thus underlining the high sensitivity of the PET insert, compared with whole-body PET systems. The computed tumor-to-reference tissue ratios exhibited an excellent accordance between the PET/MRI and PET/CT systems, with a Pearson correlation coefficient of 0.98. Mean paired relative error was 7.9% +/- 12.2%. No significant artifacts or distortions were detected in the simultaneously acquired MR images using the PET/MRI scanner.

CONCLUSION: Structural, functional, and molecular imaging in patients with brain tumors is feasible with diagnostic imaging quality using simultaneous hybrid PET/MR image acquisition.

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