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Imaging (18)F-fluorodeoxy glucose/(11)C-methionine uptake decoupling for identification of tumor cell infiltration in peritumoral brain edema.

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Abstract

Discriminating tumor infiltrative and vasogenic brain edema in malignant gliomas is important although challenging in clinical settings. This study challenged this issue by performing voxel-wise analysis of (18)F-fluorodeoxy glucose (FDG) and (11)C-methionine positron emission tomography (PET) in peritumoral brain edemas. The authors studied ten malignant glioma and nine meningioma patients with peritumoral brain edema. A voxel-wise analysis of FDG and (11)C-methionine PET was performed in order to quantify the correlation between uptake of these tracers in normal brain tissue and peritumoral brain edema. Decoupling score of the uptake of two tracers was calculated as the z-score from the estimated correlation between uptake of the two tracers in normal brain tissue. The decoupling score was also converted into images for visual inspection. Average decoupling score in the peritumoral brain edema was calculated and compared between those obtained from malignant gliomas and meningiomas. FDG and (11)C-methionine uptake showed a reproducible linear correlation in normal brain tissue. This correlation was preserved in peritumoral edema of meningioma, but not in that of malignant gliomas. In malignant gliomas, higher (11)C-methionine uptake compared to that estimated by the FDG uptake in normal brain tissue was observed, thus suggesting that decoupling was caused by tumor infiltration. Visual inspection of the decoupling score enabled discrimination of tumor infiltrative and vasogenic edema. The average decoupling scores of the peritumoral brain edema in malignant gliomas were significantly higher than those in meningiomas (2.9 vs. 0.7, $P = 0.0003$). As a conclusion, FDG/(11)C-methionine uptake decoupling score can be used for the discrimination of tumor infiltrative and vasogenic brain edema. The proposed method also suggests the possibility of accurately detecting tumor infiltration into brain tissues in gliomas, providing significant information for treatment planning and follow-up.

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