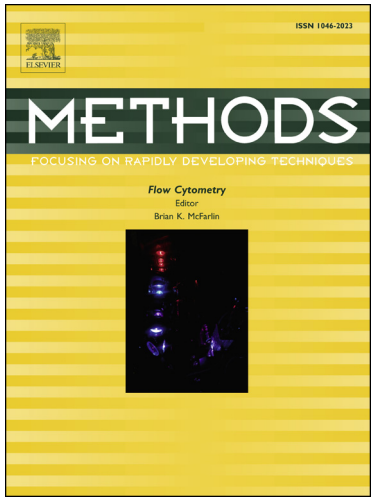

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Methods for molecular imaging of brain tumours in a hybrid MR-PET context: water content, T2*, diffusion indices and FET-PET

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Abstract

The aim of this study is to present and evaluate a multiparametric and multi-modality imaging protocol applied to brain tumours and investigate correlations between these different imaging measures (R1.1). In particular, we describe a method for rapid, non-invasive, quantitative imaging of water content of brain tissue, based on a single multiple-echo gradient-echo (mGRE) acquisition. We include in the processing a method for noise reduction of the multi-contrast data based on Principal Component Analysis (PCA). Noise reduction is a key ingredient to obtaining high-precision water content and transverse relaxation T_2* values. The quantitative method is applied to brain tumour patients in a hybrid MR-PET environment. Active tumour tissue is identified by means of FET-PET; oedema, white and grey-matter segmentation is performed based on MRI contrasts. Water content information is not only relevant by itself, but also as a basis for correlations with other quantitative measures of water behaviour in tissue and interpreting the microenvironment of water. Water content in active tumour tissue (84%) and oedema (79%) regions is found to be higher than that of normal WM (69%) and close to that of normal GM (83%). Consistent with literature reports, mean kurtosis is measured to be lower in tumour and oedema regions than in normal WM and GM, whereas mean diffusivity is increased. Voxel-based correlations between water content and diffusion indices obtained with diffusion kurtosis tensor imaging, and between quantitative MRI and FET-PET are reported for 8 brain tumour patients. The effective transverse relaxation time T2* is found to be the MR parameter showing the strongest correlations with other MR indices derived here and with FET-PET.