Hybrid MR-PET - Simultaneous FET-PET and Chemical Shift Imaging

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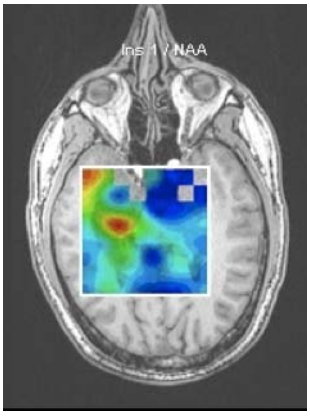
Introduction

Positron emission tomography is a widely used and established tool for clinical tumour diagnosis and is the gold standard for metabolic imaging. The method complements MR imaging with respect to its metabolic specificity and helps to judge the malignancy and extent of the tumour tissue. Recently, the need to perform two separate scans has been negated through the development of new technologies comprising MR-PET hybrid scanners. These have the advantage of measuring PET and MRI data that are intrinsically co-registered in time and space [1,2,3]. Especially with heterogeneous brain tumours or for the differentiation between active tumour mass and scar tissue after radiation therapy, MR spectroscopy may help to cross-validate and/or extend the PET data. The hybrid approach reduces measurement time and greatly aids patient compliance. This study demonstrates the feasibility of combining anatomical (MP-RAGE) and metabolic-specific information from MR spectroscopy and FET-PET in the investigation of brain tumours in humans utilising a hybrid MR-PET scanner [4].

Methods

The whole imaging protocol was performed on a hybrid MR-PET scanner consisting of a 3T MAGNETOM Tim-Trio MR scanner equipped with a BrainPET insert placed at the iso-centre and thereby allowing ***simultaneous*** MR and PET acquisition. FET-PET imaging was performed with a tracer injection of 200 MBq of the amino acid O-(2-[^{18}F]Fluorethyl)-L-Tyrosin (FET) [5,6]. The BrainPET scan time was 45 min and MRI was performed simultaneously. Anatomical images were acquired with a T_1 weighted MP-RAGE sequence in a scan time of 9 min. The matrix size was 256x256x192 to achieve a 1mm isotropic resolution. T_1 weighted FLAIR images were acquired for 26 slices. Slice thickness was 5mm and the in-plane resolution was 0.9×0.7mm^2 for an FOV of 220×220mm^2. MR spectroscopy was performed with a spin-echo CSI sequence with an echo time of 30 ms. A single plane for spectroscopic imaging with a matrix size of 12×12 was carefully placed in the tumour region based on the acquired MP-RAGE images. For fat suppression, 8 saturation bands were used and shimming was performed by hand in order to achieve an optimal line width. Image co-registration was carried out with VINCI. Results are presented from a representative patient from our collective. All patients, including the one depicted below (45 yrs, male) gave written, informed consent prior to participation. The whole study was approved by the local ethics commission.

CSI myo-Inositol / NAA

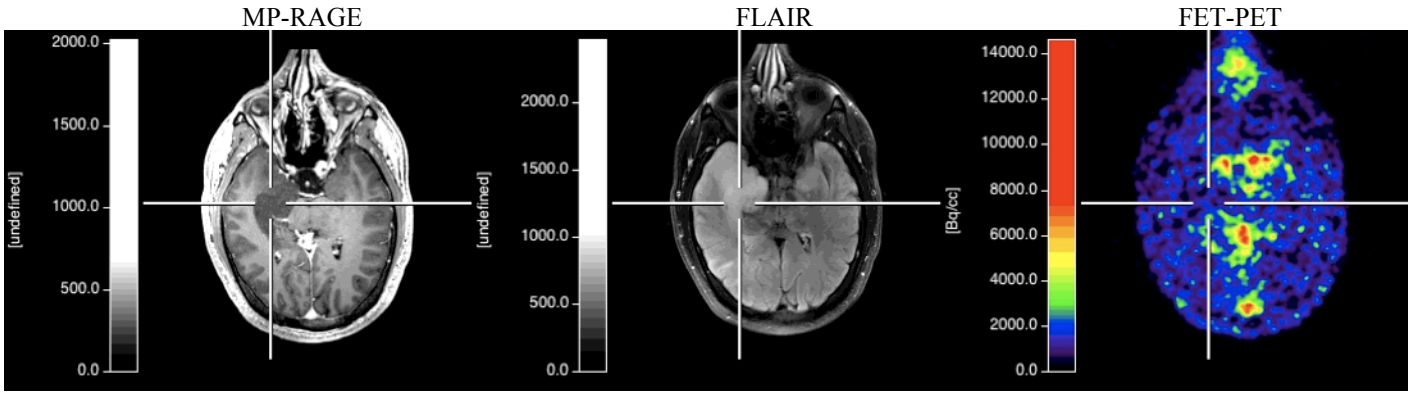


Results

MR-PET data from a representative patient from our collective of xx patients are shown here. Figure 1) shows transverse slices of the hippocampal / parahippocampal lesion in T1-weigthed MP-RAGE (left) and T2-weighted FLAIR (centre) images. The FET-PET shows no enhanced tracer uptake in the regions depicted by MRI that are hypointensive in the MP-RAGE and hyperintensive in the FLAIR images. The spectroscopy signals (Figure 2) reveal an increased relative Myo-Inositol / NAA concentration. This finding indicates an inflammation in the affected tissue [7].

Conclusions

The acquisition of multimodal MR-PET data sets can contribute significantly to differential diagnosis of pathological brain lesions. Based on the MR images the pathologic region is evaluated by FET-PET and MR-spectroscopy. In cross validation, both image modalities show that the lesion depicted in the MR images could be due to inflammation rather than being a malignant tumour.



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