

## Multi-contrast Whole-Body MRI protocol compared to Whole-Body PET/CT in Oncology

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### Purpose:

The purpose of the study was to evaluate the efficacy of a multi-contrast whole-body MRI protocol for tumor staging. The MRI protocol used a three-dimensional diffusion-weighted Echo-Planar, STIR, and T1 weighted Fast Spoiled Gradient Echo with fat suppression following gadolinium administration. Results were compared to whole-body PET/CT, the current gold standard in oncology staging.

### Introduction:

Recent publications already demonstrated great interest of the whole-body MRI (STIR and T1 weighted) [1] for tumor staging, especially in association with PET/CT [2]. Furthermore free breathing whole-body diffusion with high b value [3,4] shows high potential to improve the detection of lesions, particularly lymph nodes, which is considered today as the biggest deficiency of the T1 and STIR sequences.

### Material and methods:

15 patients (10 men, 5 women; age 44-78 years) with various primary malignancies underwent tumor staging with whole-body PET/CT and whole-body MRI covering the head to the calf. The interval time between the 2 studies did not exceed two weeks. MRI was performed on a 1.5T Signa EchoSpeed (GE Healthcare, Waukesha, WI, USA) with 33 mT/m gradients. Our protocol began with a single-shot diffusion EPI sequence. 5 stations of 30 contiguous axial slices (7-mm thick) covering the body are used to acquire data displayed by a maximum intensity projection. Acquisition parameters were: TR/TE of 7100/85 ms, matrix of 80X128, field-of-view 36X36 cm<sup>2</sup>, b=600 s/mm<sup>2</sup>. A 5-station coronal Fast STIR was acquired with the following parameters (TR 8400/30 ms, TI 145 ms, 8-mm thick sections with 1-mm gaps, matrix of 320 x 224, field-of-view 44X44 cm<sup>2</sup>). Finally, a 5-stations 3D T1 weighted Fast Spoiled Gradient Echo with a spectral fat suppression (LAVA) following gadolinium administration (0,1 mmol/kg) was added (TR 5,8/4,2 ms, TI 145 ms, 4-mm thick sections (interpolated), matrix of 352 x 224, field-of-view 44X44 cm<sup>2</sup>). Total acquisition time of the complete MR examination was 45 min (patient's installation included). Integrated Body coil was used except at the thoraco-abdominal level where the 8ch Body array coil was implemented to realize breath-hold acquisition.

PET/CT imaging was accomplished one hour after intravenously injecting 296-444 MBq of [18F]-2-fluoro-2-deoxy-D-glucose (FDG).

Two radiologists in consensus evaluated MRI data sets. Two nuclear medicine physicians additionally viewed PET/CT images. Readers were blinded to the results of the other imaging procedure and diagnostic accuracies of the two imaging procedures were compared for assessing the TNM stage. Histology and a clinical follow-up served as the standards of reference.

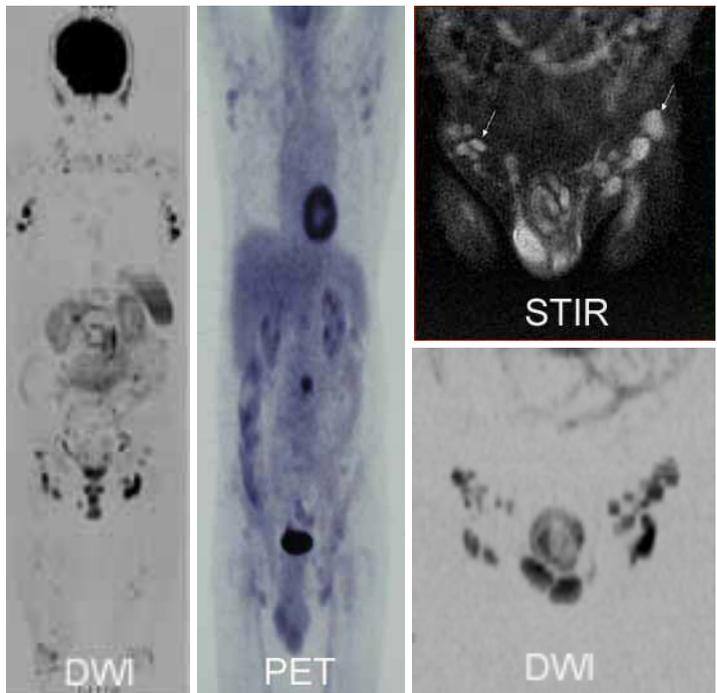
### Results:

Concordance between whole-body MRI and PET/CT occurred in 10 of 15 patients (66%). Two vertebral metastasis in 2 patients were not identified at PET/CT, but visible in MRI and were confirmed, one by histology, the other by follow-up. In one patient with Non-Hodgkin's lymphoma, a diffuse bone marrow infiltration, clearly visible with MRI (especially in diffusion acquisition) and confirmed by histology, was missed with PET/CT. 128 lymph nodes were identified in 5 patients (hypermetabolic in PET and in hypersignal in STIR and diffusion with MRI). In 2 patients, inguinal lymph nodes considered as non-hypermetabolic in PET/CT, were positive with MRI (STIR and DWI) and histologically proven lymphomatous (figure 1). 36 and 37 distant metastasis were detected respectively by MRI and PET/CT: in 1 patient (pulmonary adenocarcinoma), PET/CT revealed lesions one on clivus and one paravertebral C2, non clearly visible with MRI. In another patient (colic adenocarcinoma), PET/CT revealed two right intra-hepatic foci (max SUV 3,7), without correlation with MRI, CT and sonography.

### Conclusion:

The use of a high b value diffusion-weighted sequence in the Whole-Body MRI protocol improved the detection of secondary lesions, in particular lymph nodes. Compared to PET/CT, MRI was more sensitive in the detection of bone metastasis, bone marrow infiltration, and lymph nodes. Coronal MRI sequences only appear less sensitive in the analysis of coronal-oriented anatomical structures (like clivus, scapula...) and skull base, where diffusion-weighted has some limitation due to signal inhomogeneity.

**Figure 1:** Histologically proven invaded subdiaphragmatic and inguinal lymph nodes appear clearly positives with MRI (supracentimetrics, hypersignal diffusion and STIR) and non-hypermetabolic in PET/CT.



### References:

- [1] Eustache S. et al. *AJR*, 1997; **169**,1655-1661.
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- [3] Ballon D. et al. *ISMRM* 2003
- [4] Ballon D. et al. *Mag. Reson. Med*, 2004 ; **52**, 1234-1238.