

## Whole body 18FDG-PET/MRI as compared with 18FDG-PET/CT in metastatic breast cancer

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**Target Audience:** Radiology clinicians and researchers interested in oncology, breast cancer and PET/MRI applications.

**Purpose:** Assessment of systemic disease in metastatic breast cancer comprises the basis for clinical care. Current staging, however, is non-standardized, so many patients undergo no whole body (WB) staging at all, and approximately 7% of these patients will have had metastatic disease at the time of their diagnosis. In patients who do undergo WB staging, 18FDG-PET/CT is the standard of practice. 18FDG-PET/CT demonstrates high physiologic uptake in the brain and liver that can obscure underlying lesions such that the brain is not routinely included. Brain and liver are important sites for early detection as these metastases can be treated locally, providing improved local control and survival. Moreover, 18FDG-PET/CT exposes patients to a relatively high radiation dose and is often performed serially in young breast cancer patients. The Lifetime Attributable Risk (LAR) of radiation induced cancer due to a single 18FDG-PET/CT has been estimated up to 0.5% in young American women. Our aim, therefore, is to compare 18FDG-PET/MRI with 18FDG-PET/CT to compare lesion detection and radiation doses in order to establish the safest, most biologically relevant whole body imaging for

breast cancer patients.

**Methods:** Prospective, HIPAA compliant, IRB approved. 50 women (age 31.6-78.5 years, mean 56) with n=9 newly diagnosed or n=41 history of metastatic breast cancer underwent WB simultaneous 18-FDG-PET/MR on an integrated 3T PET/MR scanner (Siemens Biograph mMR) 116-260 minutes, mean 173) after 18-FDG injection for their clinical PET/CT. Following WB GRE scout, a WB exam was conducted with a set of flexible body matrix coils from thighs to vertex with the patient prone, with (49) or without (n=1) rapid bolus injection of 0.1 mmol/L of gadopentetate dimeglumine (Magnevist, Bayer)/kg body weight at 2.0 mL/sec IV with the following protocols per station: (1) 3D coronal VIBE Dixon for PET attenuation correction (AC), (2) prototype T1

weighted radial VIBE and (3) 2D double- refocused echo- planar, diffusion weighted imaging (TR/TE =6000 / 65 ms, FOV 450 mm, 2.3x2.3x6mm voxel, SPAIR fat-suppression, three diffusion directions (3-scan trace) and b-values 0, 350, and 700 s/mm<sup>2</sup>). 5 subjects did not complete the brain station. PET events were accumulated for 6 min per station and images were reconstructed incorporating u-maps from the AC scan. PET/MRI and PET/CT images were read from Mirada-64 (Mirada), each by 2 radiologists with 1-2 (PET/MRI) and 1-12 (PET/CT) years experience in their modality. Readers were blinded to other exams and prior reports. Number of metastases up to 6 per organ system (axillary node, other node, liver, lung, bone, brain), number of breast malignancies and radiation dose were recorded and analyzed. Unblinded review of all prior and follow-up examinations and pathology reports, together with the read of our institution's two most experienced PET/MR readers served as the reference standard.

**Results:** There were 219 malignant lesions in 25 of 50 women: 18 axillary nodal, 40 other nodal, 31 liver, 12 pulmonary, 80 bone, 15 brain and 16 breast lesions in 7, 10, 9, 2, 19, 5 and 14 patients each. Subject-level lesion detection in each organ system per reader is detailed in fig 1. Per patient organ system, both more false negatives and more false positives were seen with PET/CT as compared with PET/MRI (fig 2a and b). Importantly, PET/MRI detected brain (n=5), liver (n=2) and bone (n=1) metastases and breast malignancies (n=5) in 11 unique patients that were not seen by either PET/CT reader. Overall average reduction in radiation dose was 50% (range 19.6-65.4%). For PET/MRI, radiation dose ranged from 9.2-11.1mSv, mean 10.4mSv and from 15.4-30.2mSv, mean 20.1mSv for PET/CT.

**Conclusion:** PET/MRI appears to outperform PET/CT in detection of malignant brain, liver, bone and breast lesions at half the radiation dose of PET/CT.

