

Focused primary tumour staging and WB-MRI distant disease assessment: a potential all-in-one staging tool

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Introduction To facilitate accurate staging oncology patients frequently undergo multiple investigations using a variety of imaging modalities. It has been proposed that the traditional multi-imaging approach could be replaced with one whole-body MRI (WB-MRI) scan with considerable savings in time, expense and radiation (ionising) dose. Currently little data has been published regarding WB-MRI performed on 3.0T MRI scanners. The aim of this study was to investigate the feasibility of a focused primary tumour (breast or prostate) examination in combination with WB-MRI for staging of distant disease. If successful we propose the addition of a focused primary tumour and WB-MRI scan, acquired in one imaging session, could allow the omission of other examinations, such as radionuclide imaging, thereby streamlining the current imaging pathway.

Methods MR imaging was performed on either a 3.0T Signa HDx or Discovery MR750 scanner (GE Healthcare, Milwaukee, USA). To facilitate morphological and functional imaging of the primary tumour patients were either positioned prone on an 8 channel breast coil or laid supine on a 32 channel torso coil. For all patients the integral body coil was used for WB-MRI imaging. The WB-MRI imaging protocol has undergone several iterations and currently comprises of the following: axial stations were acquired for DWI extending from the vertex of the skull to the mid femur level utilising the following parameters: single shot spin echo EPI, $b=0$ and 800s/mm^2 , FOV $440\times 330\text{mm}$, slice/gap $8/0\text{mm}$, matrix 64×94 , TE 73.4ms , TR 4000ms , 4 NEX. The axial plane was chosen to reduce geometric distortions to a minimum. The $b=800\text{s/mm}^2$ diffusion images from each station were then bound together, reconstructed in the coronal plane and finally the image contrast inverted. In phase T1-W and water only +Gd T1-W images were acquired using a 3D LAVA DE sequence (two point Dixon sequence providing in and out of phase T1-W gradient echo images in addition to processed water and fat only images). These images were acquired in the coronal plane over four stations from the vertex of the skull to below the knees with the following parameters: FOV $460\times 460\text{mm}$, slice/gap $5/0\text{mm}$, matrix 256×224 , out of phase TE 1.2ms , in phase TE 2.4ms , TR 3.8ms , 1 NEX, scan time per station 20seconds. The fast imaging time facilitated a breath held technique for stations imaging the thorax and abdomen. Individual stations were pasted together providing maximum SI coverage. Additionally, STIR images were acquired coronally again utilising a multi station approach: FOV $460\times 460\text{mm}$, slice/gap $10/1\text{mm}$, matrix 224×160 , TE 35.4ms , TR 6650ms , TI 180ms , 2 NEX.

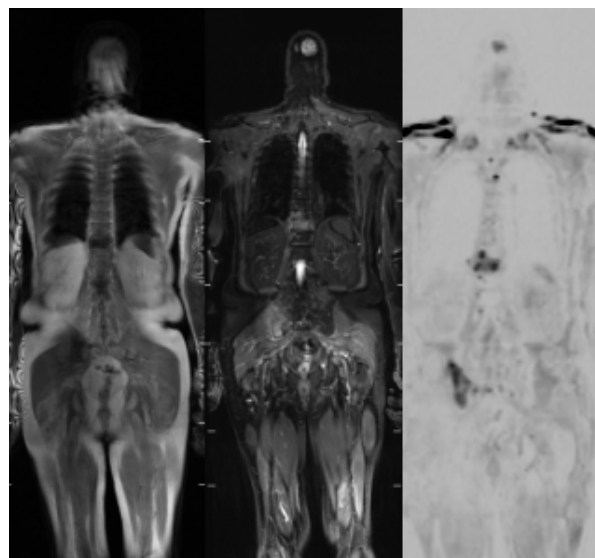


Fig. 1. In phase, STIR and DWI whole body images from a prostate patient demonstrating metastatic bone disease.

Results Focused primary tumour in combination with WB-MRI examinations were successfully obtained in over 20 patients. Examples of WB-MRI are presented in Fig. I and II for a prostate and breast patient respectively. The resulting image quality was generally good, however, some artefacts were noted particularly water/fat phase shift and fringe field artefacts related to 3D LAVA and DWI respectively. Generally, MR results were comparable with other imaging modalities. However, in the breast patients the lack of a dynamic MR liver investigation was felt to be problematic.

Conclusions Focused primary tumour (breast or prostate) examination in combination with a WB-MRI for staging of distant disease is feasible. However, the technique needs to be validated in a much larger cohort than the one studied.

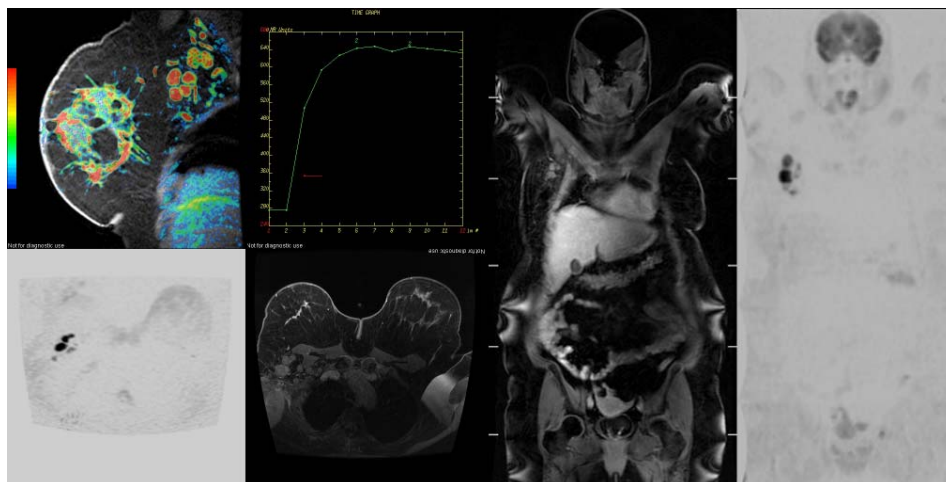


Fig. II. Focused breast examination revealing a diffusely invasive carcinoma with enlarged axillary nodes. T1-W water only +Gd LAVA DE and DWI whole body images confirmed the axillary node involvement but failed to demonstrate any further disease.