Whole body diffusion weighted imaging for distant staging in colorectal cancer – feasibility and future challenges

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Purpose:

Patients with colorectal cancer are screened for distant metastases to evaluate their prognosis and determine the appropriate treatment plan. To perform a complete distant staging, multiple examinations, consisting of liver and/or chest CT, chest X-ray, liver ultrasound and/or PET-CT are generally required. CT and PET-CT are the most well known 'one-stop-shop' techniques for whole body screening, but require a relatively high dose of ionising radiation. Whole body diffusion weighted MRI (WB-DWI) is a new concept, that might prove to be a promising alternative. Diffusion MRI derives its contrast directly from differences in tissue cellularity and has been reported to be promising for the discrimination between tumoural and non-tumoural structures throughout the body. The maximum intensity projection (MIP)reconstructions of WB-DWI render PET-like images. The purpose of this study was to evaluate the feasibility of WB-DWI for (local and) distant staging in rectal cancer and compare the lesion detectability with conventional distant staging techniques (CT and/or PET-CT).

Materials and Methods:

6 healthy volunteers (3 male, 3 female, mean age 24 yrs) and 10 rectal cancer patients (8 male, 2 female, mean age 62 yrs) with known distant metastases underwent WB-DWI (DWIBS-method[Takahara et al, 2004],b-values 0,800 s/mm^2,scantime 16 minutes). Six patients were scanned at primary staging, 2 after long course chemoradiation (CRT) and 2 both pre- and post-CRT. 3D MIP reconstructions in inverted greyscale were generated for image evaluation. Two readers analysed all images (in consensus) for suspected lesions. Histology was the standard reference for the primary tumors. CT (n=6), PET-CT (n=4) and histology (n=4) were the reference for distant metastases.

Results:

Image quality was good in all 16 subjects. The MIP-reconstruction images greatly resembled the PET-images. All 10 rectal tumors (100%) were visualised on WB-DWI. On (PET-)CT, the 10 patients presented with a total of 65 distant metastases (43 liver metastases,19 lymph-node metastases and 3 lung metastases), of which 13 were histologically confirmed. 55/65 lesions (85%) could be identified on the WB-DWI images. In two patients after chemotherapy, residual liver lesions (3-17 mm) that were still visible on CT and histologically confirmed after liver surgery could not be identified on DWI. In all volunteers and patients, pronounced axillary and inguinal lymph nodes were visible. These nodes visually resembled the metastatic nodes along the abdominal en inguinal vessels as seen in the patients with distant lymph node metastases. These benign nodes in the axillary and inguinal region could therefore potentially harbour a risk for false positives.

Conclusions:

WB-diffusion images of adequate quality can be obtained within an acceptable timeframe. Lesion detection is promising, but with a risk for false positives. After chemotherapy, WB-DWI seems to have limitations in detection of residual lesions.

Though several challenges need to be addressed, whole body diffusion weighted MR imaging may potentially become a promising alternative for established staging techniques, such as PET and CT.

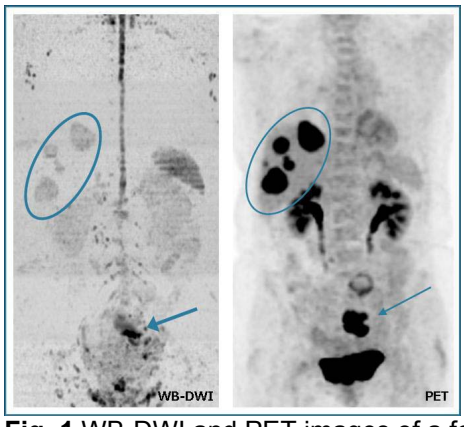

Fig. 1 WB-DWI and PET images of a female patient with multiple liver metastases (circles) originating from a rectal tumour (arrows). Note the pronounced nodes in the axillary region on WB-DWI

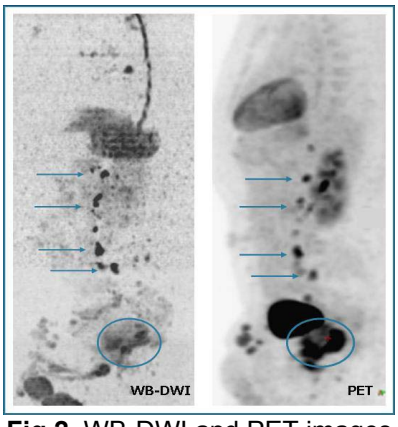

Fig 2. WB-DWI and PET images of a male patient with massive nodal metastases along the abdominal aorta (arrows) originating from a big rectal tumour (circles).