Whole Body-MRI imaging with a continuously moving table platform in detection of metastatic disease in cancer patients
First Results of a feasibility study

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Abstract
The purpose of this study was to evaluate a new protocol for axial Whole Body-MRI imaging performed with a continuously moving table platform in comparison to Whole Body-MRI using a multi-station coronal Turbo-STIR as a staging and screening method in cancer patients. The first results of our study demonstrated that Whole Body-MRI as a fast and accurate examination in cancer patients in nearly 10 minutes is feasible and comparable to Whole Body-MRI using a turbo-STIR-sequence combined with a rolling table platform. Whole Body-MRI imaging may compete with the established imaging technique like skeletal scintigraphy and FDG-PET in cancer patients.

Introduction
Computed tomography, skeletal scintigraphy, MRI and PET are staging procedures of clinical routine which are used for the detection of metastatic disease in cancer patients. Usually, MRI is restricted to a single body region due to the limited field of view whereas imaging techniques like PET, CT and skeletal scintigraphy can be performed as whole body examination for staging and screening cancer patients. On the basis of the rolling table platform with integrated surface coil, MRI is feasible for tumor staging and screening cancer patients (1, 2). The coronal view might lead to false-negative imaging findings due to small lymph nodes which were not clearly depicted in coronal images and might be not seen (3). Therefore, the purpose was to evaluate a new clinical protocol for Whole Body-MRI image with a continuously moving table platform by using an axial HASTE-STIR-sequence.

Methods
Five cancer patients with different tumor entities are studied prospectively by both Whole Body-MRI imaging techniques. A new clinical protocol for axial Whole Body MRI imaging which is motion insensitive and is characterized by a defined T2 and/or IR-T2 weighted contrast was established employing a single shot HASTE-sequence during automatic continuous table motion. Matrix size was 179 x 256, yielding an echo train length of $T_{E1} = 334$ ms. For T2-contrast an echo time of $TE = 74$ ms was used. STIR-imaging was performed by means of an IR-preparation ($T_{I} = 160$ ms). For a necessary SAR-reduction, the HASTE sequence was modified by using TRAPS [4]. After the examination a complete coronal and sagittal reconstruction was performed as post-processing. Before starting this prospective study, there was a feasibility study including five volunteers. A multi-station coronal Turbo STIR Whole Body-MRI using a rolling table platform, Whole Body FDG-PET and skeletal scintigraphy were done for staging and screening of tumors within a week. Between MRI and PET examination no radiation therapy or chemotherapy was performed. Within the two last months prior to PET no previous chemotherapy was performed. The findings of the two different Whole Body-MRI investigations (n=5) Whole Body FDG-PET (n=5), skeletal scintigraphy (n=4) were compared by a lesion analysis. Soft tissue mass, lymph node metastases, bone and metastases were evaluated separately. The coronal multi-station MRI examinations were performed using a rolling table platform, a body surf coil with an unlimited field of view with a 1.5 Tesla system (Magnetom Sonata, Siemens, Erlangen, Germany) equipped with a high performance gradient (40 mT/m, amplitude, slew rate 200 mT/m/sec). A multi-station coronal Turbo-STIR-sequence (TR5500-4200/TE102-94/TI160) was used for the different body lesions including head, neck, thorax, abdomen, pelvis and lower extremities. For FDG-PET 300-500 MBq of FDG were injected intravenously, the uptake time was 90 min. The data were acquired with two-dimensional rings (ECAT EXACT Siemens/CTI Knoxville, Tennessee, USA) Skeletal scintigraphy was done with a 99 mTC-DPD. The evaluation of all investigations was done by two experienced radiologists, nuclear physicians, blinded to the clinical results and to the results of the second imaging technique.

Results: In comparison to Whole Body-FDG-PET and skeletal scintigraphy as gold standard in tumour staging and screening, continuously moving Whole Body-MRI detected 4/4 primary tumors, 8/9 lymph node metastases, 2/2 pulmonary metastases and 4/4 bone metastases. In one case of these positive concordant Whole Body imaging findings continuously moving Whole Body-MRI detected one skeletal metastases, whereas the coronal multi-station Whole Body-MRI failed to detect this metastases. In one patient continuously moving Whole Body-MRI, coronal multi-station Whole Body-MRI, skeletal scintigraphy and Whole Body-FDG-PET excluded a malignant tumor. Regarding the contrast resolution, PET was superior to MRI, although MRI gave additional anatomical information. Pulsation and motion artefacts which restricted the diagnostic accuracy of the coronal multi-station Whole Body MRI were not seen in continuously moving Whole Body-MRI.

Discussion
Our preliminary results suggest that the continuously moving whole Body MRI is an effective method for examining cancer patients by the use of a rolling table platform. In agreement with the literature whole Body MRI is a fast and accurate diagnostic tool for evaluation metastastic disease in cancer patients (1-3). The typical problem of MRI coping with a restricted field of view seems to be solved by the rolling table platform enabling to perform whole body MRI in a short time. Limitations of coronal Turbo-Stir Whole Body MRI are caused by motion- and pulsation artifacts of adjacent organs are solved by the axial motion-insensitive Whole Body Imaging. The clinical potential of whole body MRI must be proved in further clinical studies by larger series in comparison to routine staging procedures such as computed tomography, MRI, PET and bone scintigraphy.

References
3. Ghanem N et al., Cancer Imaging 3,15-20
4. Hennig J et al., accepted MRM 102-5928