MOVING DURING SCAN: Whole Body MRI in Clinical Routine in 50 Patients

N. A. Ghanem[1], T. Bley[1], C. Müller-Mall[1], H. P. Fautz[1], G. Sommer[2], U. Ludwig[2], J. Hennig[2], M. Langer[1]

[1]Dept of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany, Germany, [2]Dept of Radiological Research, University Hospital Freiburg, Freiburg, Germany, Germany

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 50 patients with different cancer or muskuloskeletal diseases. The results of our study demonstrated Whole Body-MRI as a fast and accurate examination in cancer patients in nearly 10 minutes, which is feasible and comparable to Whole Body-MRI using a turbo-STIR-sequence and T 2 HASTE-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 in clinical routine. Usually, MRI is restricted to a single body region due to of 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).

Methods: 31 patients with different malign tumor entities and 19 patients with muskuloskeletal diseases were studied prospectively by both Whole Body-MRI imaging techniques. A new clincal protocol for axial Whole Body-MRI imaging which is motion insensitive and is charcterized by a defined T2 and/or IR-T2 weighted contrast was established employing a single shot HASTE-sequence during automatic continous table motion. Matrix size was 179 x 256, yielding an echo train length of T_{ETL} = 334ms. For T2-contrast an echo time of TE = 74ms was used. STIR-imaging was performed by means of an IR-preperation (TI =160ms). For a necessary SAR-reduction, the HASTE sequence was modified by using TRAPS (4). 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 tumorous lesions and muskuloskeletal lesions within four weeks.

Between Whole Body-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=50), Whole Body FDG-PET (n=12), skeletal scintigraphy (n=14) were compared by a patient analysis followed 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/max. 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, Knowville, Tennessee, USA) Skeletal scintigraphy was done with a 99 mTc-DPD. Conventional CT (n=13) and MRI (n=10) was compared to the findings of Whole Body MRI .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 (n=12) and skeletal scintigraphy (n=14) as gold standard in tumour staging and screening, continously moving Whole Body-MRI detected primary disease in 6/6 cases (skeletal scintigrahy) and 4/4 cases (Whole Body-FDG-PET). Skeletal scintigraphy failed to detekt in 2 cases, Whole-Body-FDG-PET was false-negativ in 2 cases; whereas Whole Body-MRI was right-positive in these cases. In a further comparison considering 50 patients coronal multi-station Whole Body-MRI and continously moving axial Whole Body-MRI showed in 36 cases positiv and in 13 cases negativ concordant results. In one case both methods have shown a false-negative result, whereby in one further false-negative case only the coronal multi-station Whole Body-MRI failed to show the right result. Considering soft tissue metastases, Whole Body-MRI detected 5/6 lesions and 15/15 bone marrow lesions compared to Whole Body-FDG-PET. In 84 possible regions, Whole Body-MRI lead to positive results in 21/19 cases compared to Whole Body-FDG-PET, Whole Body-MRI detected in 6/7 cases positive thoracic results, whereby in the spine in 5/2 cases positive results could have been shown compared to the Whole Body-FDG-PET. Comparing skeletal scintigraphy to Whole Body-MRI, Whole Body-MRI detected 17/12 skeletal lesions and was positive in 20/13 of 98 possible regions. At pelvis (4/1) and spine (3/1) Whole Body-MRI was superior to skeletal scintigraphy. Concerning the imaging findings of conventional CT and MRI, Whole Body MRI detected only 10 and 7 lesions, whereas CT and MRI were superior by demonstrating 13 and 10 lesions

In a further region comparison of multi-station coronal Turbo STIR Whole Body-MRI and continously moving axial Whole Body-MRI, multi-station coronal Turbo STIR Whole Body-MRI was positive in 99 of 350 possible regions, wherby continously moving axial Whole Body-MRI using STIR-sequenze detected 89/350 possible positiv regions and T2 HASTE 53/350 positive results. In a lesion-to-lesion analysis the coronal process detected 9 thoracic pathological lymphatic nodes, wherby the axial STIR was capable to detect 15 lesions, and 12 detected by continously moving axial Whole Body-MRI using T2 HASTE. Considering all lymphatic lesions, multi-station coronal Turbo STIR Whole Body-MRI found 36 positive results, axial Whole Body-MRI using STIR 38 lesions and 29 lesions by the T2 HASTE. 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 continously moving Whole Body-MRI.

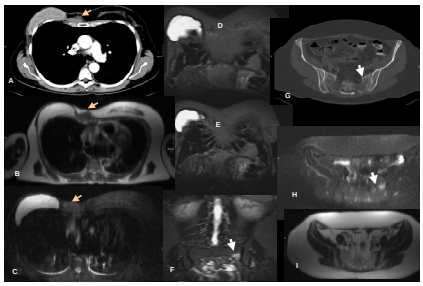

Figure 1: Axial continously moving Whole Body-MRI (Moving During Scan) using STIR (c) and HASTE/STIR (b) demonstrated a recurrent disease of breast cancer in the right chest wall in concordance to the CT-findings (a). Coronal multi-station Whole Body-MRI failed to detect a relapse (d, e), however coronal multi-station Whole Body-MRI detected a skeletal metastases of the pelvis (f) confirmed by CT (g), axial continously moving Whole Body MRI using STIR-sequence (h). The axial continously moving Whole Body MRI using a HASTE-sequence was false negative indicating no lesion (i).

Discussion: Our preliminary results suggest that **MOVING DURING SCAN** 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. The clincal potential of whole body MRI performing **MOVING DURING SCAN** must be proved in further clinical studies by larger series in comparison to routine staging procedures such as computed tomography, MRI, Whole Body-MRI, PET and bone scintigraphy.

References

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