

Comparison of a new whole body continuous table movement versus a standard whole body MR protocol for the assessment of multiple myeloma

S. Weckbach¹, H. J. Michaely¹, A. Stemmer², S. O. Schoenberg¹, and D. J. Dinter¹

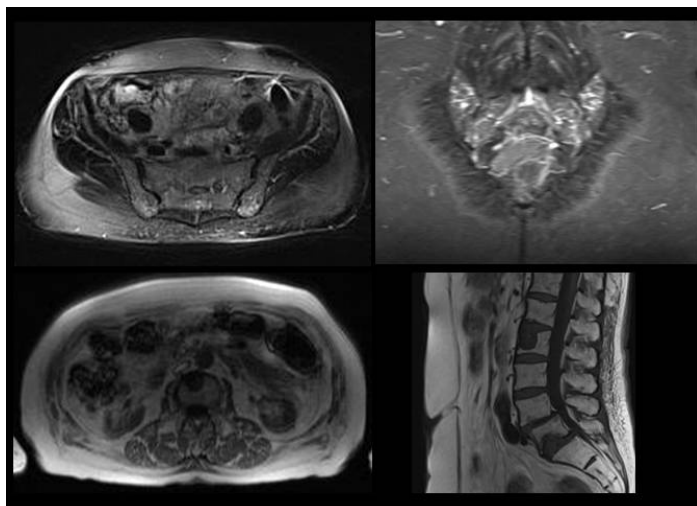
¹Department of Clinical Radiology and Nuclear Medicine, University Hospital Mannheim, Mannheim, Germany, ²Imaging & IT Division, Magnetic Resonance, Siemens AG, Healthcare Sector, Erlangen, Germany

Purpose: Exact staging is of high importance in patients with multiple myeloma. It has a major influence on the identification of the patients' risk, life expectancy and on patient management [1, 2]. However, despite using parallel imaging techniques whole body (WB) MRI protocols take appr. 45 min compared to appr. 30 min for a skeletal survey which is not fast and competitive enough for a high patient throughput in clinical routine. In a few recent studies continuous table movement (CTM) MR protocols were investigated for oncological imaging and have proven feasible [3-7]. The purpose of this study was to evaluate a new WB continuous table movement (CTM) MR protocol for the assessment of patients with multiple myeloma in comparison to a step-by-step standard WB MR protocol as reference.

Material and Methods: A total of 18 patients with multiple myeloma were included in this prospective study. Patients were examined at 1.5 T (MAGNETOM Avanto, Siemens AG, Healthcare Sector, Germany) using a vendor supplied works in progress package CTM MR protocol consisting of an axial CTM T2-w fs BLADE (TR 1500 ms, TE 60 ms, TI: 150 ms, FOV 400 mm², 1.6 x 1.6 x 6 mm³, parallel imaging factor 2) and an axial T1-w gradient-echo (GRE) sequence (TR 131 ms, TE 4.76 ms, FOV 420 mm², 1.8 x 1.6 x 6 mm³, parallel imaging factor 2). As standard of reference conventional step-by-step standard WB coronal T1-w SE and T2-w STIR sequences as well as sagittal T1-w TSE and T2-w STIR sequences were acquired. Imaging time was assessed. Two radiologists rated in consensus image quality, severity of artifacts, assessability of the liver and spleen, the ability to depict bone marrow lesions smaller/larger than 1 cm, diffuse infiltration and the detectability of soft tissue lesions. It was investigated whether the use of the CTM protocol resulted in a change in the patients' Durie and Salmon Plus stage. The assessability of complications such as vertebral fractures were assessed. Readers were allowed to reformat CTM sequences online in sagittal and coronal orientation. For statistical analysis Chi-Square tests and Wilcoxon tests were performed.

Results and Discussion: The mean protocol time was 24:32 (SD 3:50) min for the standard protocol compared to 6:38 (SD 2:08) min for the CTM protocol. In 72 % image quality was rated good for both the CTM and standard protocol, in 27 % image quality was moderate for the CTM protocol and good for the standard protocol without a statistically significant difference ($p = 0.0625$). In 50% of patients artifacts were rated as mild, but non-disturbing for both protocols, whereas in 50% of patients artifacts were classified as disturbing for the CTM protocol ($p = 0.0039$). Lesion depiction for lesions smaller / greater than 1 cm as well as for diffuse infiltration was identical with both protocols. In none of the patients a shift in the Durie and Salmon Plus stage occurred. Detectability of soft tissue lesions was identical with both protocols. Organ assessability was better using the CTM protocol in 33 % of patients with statistically significant better results for the CTM T2-w fs BLADE compared to the standard STIR sequence ($p < 0.001$). Vertebral fractures seen with the standard protocol could not be detected by the CTM protocol due to limited quality of the sagittal reformations.

Figure 1.



Upper row:

Example of a moderate diffuse infiltration pattern in a 62 year old female patient (Durie and Salmon Stage II) which is comparably depictable with the CTM T2-w fs BLADE sequence (left) and the coronal standard STIR sequence (right).

Lower row:

Focal lesion larger than 1 cm in a 74 year old female patient in L 2 (Durie and Salmon Stage I). The lesion is excellently illustrated in both the CTM T1-w GRE and standard sagittal T1-w sequence.

Conclusion: The new WB CTM protocol allows the assessment of patients with multiple myeloma with comparable image quality and identical ability to detect bone marrow and soft tissue lesions compared to the standard protocol with even better organ assessability. Scan time is reduced by 75%. Taking into account the limitations of the technique concerning vertebral fracture assessment this new protocol seems advantageous for patients with pain, allows a higher patient throughput in clinical routine and might facilitate the depiction of extramedullary lesions.

References:

- [1] Kyle RA, Rajkumar SV N Engl J Med. 2004;351:1860-1873.
- [2] Kyle RA, Rajkumar SV Blood. 2008;111:2962-2972.
- [3] Brauck K, Zenge MO, Vogt FM, et al. Radiology. 2008;246:910-916.
- [4] Baumann T et al Eur J Radiol. 2009.
- [5] Baumann T et al. Invest Radiol. 2008;43:359-367.
- [6] Sommer G et al. J Magn Reson Imaging. 2008;27:666-672.
- [7] Bley TA et al. In Vivo. 2007;21:891-894.