# Multi-contrast whole-body 2D axial MR imaging during continuous table movement for tumor staging

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## Introduction

In patients suffering from malignant diseases, therapeutic options as well as the patients' prognoses strongly depend on the presence of metastases. Clinical studies have demonstrated that magnetic resonance imaging (MRI) is superior to conventional modalities for detection and characterization of parenchymal and osseous lesions. [1] A major drawback of conventional MRI is the restricted field of view, which allows imaging of a single body region only. Advances in scanner technology and the introduction of moving patient platforms with integrated surface coils have enabled whole-body MR imaging within a single session. However, artifacts caused by involuntary patient movement, insufficient breath holding, or pulsation of the heart can significantly reduce image quality. To overcome these limitations, real-time whole-body SSFP imaging using 2D axial slices during continuous table movement was introduced.[2] The major limitation of this approach was the restriction to a single image contrast determined by T2*/T1 properties of the tissues. These steady state free precession sequences excellently demonstrate morphology, but the accuracy for the detection of metastases in parenchymal organs, e.g. the liver, is limited. Therefore, our study aimed to develop a multi-contrast MR protocol for real-time whole-body imaging and to compare the results with PET/CT as the standard of reference.

## Materials and Methods

Thirteen patients (6 women and 7 men, mean age 55 years) referred to PET/CT (Biograph, Siemens AG, Erlangen) for tumor staging were included. All patients had a history of malignant or benign tumors (colon carcinoma n=4, bronchial carcinoma n=2, gastrointestinal stroma tumor, urothelial carcinoma, non-Hodgkin lymphoma, ovarian cancer, thymus carcinoma, sarcoma and hemangioblastoma). The MRI examination was performed on a 1.5 T whole-body system (Magnetom Sonata, Siemens AG, Erlangen) equipped with a rolling table platform (BodySURF, MR-Innovation GmbH, Essen, Germany) which allows manually sliding the patient over the stationary patient table between the posteriorly located spine coil and the anteriorly located body phased array. During the examination, the position of the table was recorded using a high-precision laser distance sensor (DME 5000, Sick AG, Waldkirch, Germany). Real-time axial sequences, pre and post administration of contrast (0.2 mmol/kg Magnevist (Schering AG, Berlin, Germany), were used for the examination of the entire body from head to toe (T1-w: TR/TE: 2.08/1.04 ms, FA: 50°, pseudo T2-w: TR/TE: 2.34/1.17 ms, FA: 55°). The T2-w sequence was only used before administration of contrast agent. The slice thickness was 5 mm and a matrix of 192x128 was used for all sequences.[3] The PET/CT examination was performed on a Biograph dual-modality PET/CT after administration of FDG (dose: 320 MBq) and iodinated contrast (dose: 140 ml).

## Results and Discussion:

The real-time whole-body MRI protocol could successfully be performed in all patients. The measurement of the z-position using a laser sensor allowed sagittal and coronal reconstructions. However, inconsistencies in the table velocity due to manual movement resulted in minor contrast variations perpendicular to the direction of table movement. All pulmonary (n=8) and hepatic (n=6) (Fig. 1) metastases with a diameter greater than 6 mm detected by PET/CT could be visualized by real-time MRI, but MR missed 3 of 8 lesions with a diameter below 6 mm. In three patients, whole-body MRI showed additional osseous lesions which were not detected by PET/CT. These lesions were confirmed by follow-up examinations. The contrast-enhanced T1-w real-time sequence was most accurate for tumor detection.

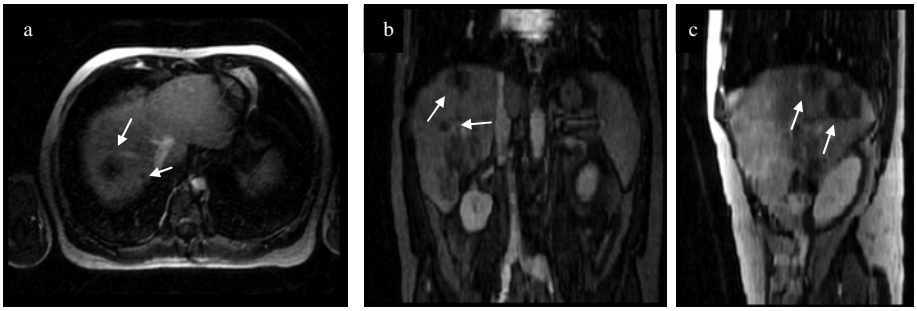


**Fig. 1:** Patient suffering from a colon carcinoma with multiple liver metastases: a) axial source image after contrast injection; b) and c) reconstruction of the liver from the thoracic level down to the kidneys. Metastases are clearly visible (arrows) in a) as well as in b) and c).

## Conclusion:

Multi-contrast real-time axial imaging combined with BodySURF allows interactive MRI of multiple body areas. This approach overcomes limitations inherent to conventional MR: real-time scanning eliminates motion artifacts and the rolling table platform extends the restricted field of view up to 2000 mm. The excellent agreement with PET/CT as the standard of reference encourages larger clinical studies to assess the diagnostic accuracy of this technique.

## References:

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